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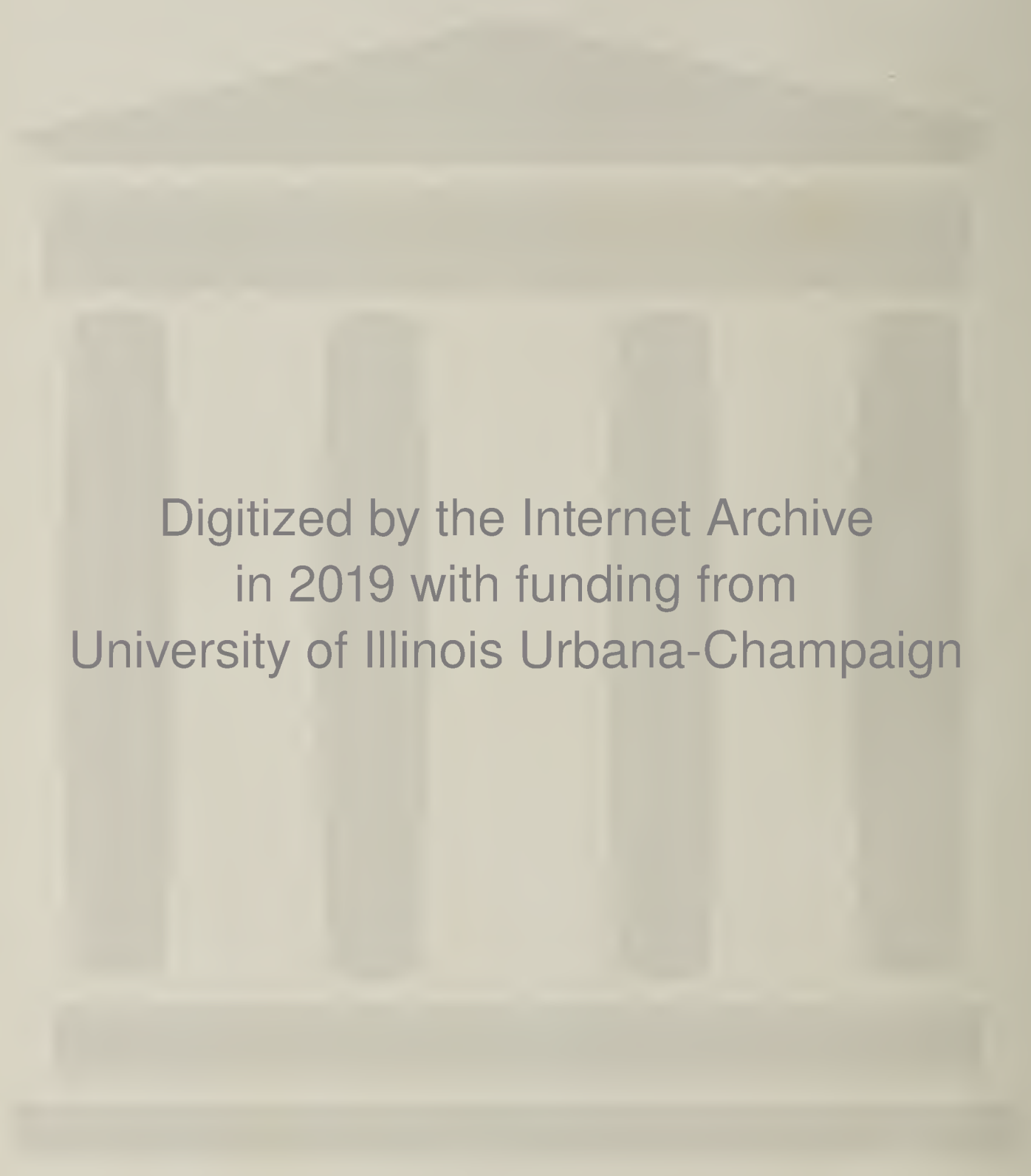
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BULLETIN

VOLUME XI

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

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CONTRIBUTIONS TO THE SURGERY OF THE BILE PASSAGES, ESPECIALLY OF THE COMMON BILE-DUCT.*

BY W. S. HALSTED, M. D., *Baltimore, Surgeon-in-Chief to the Johns Hopkins Hospital, Professor of Surgery in the Johns Hopkins University.*

Just now I am very much impressed with the splendid results of operations for gall-stones in the common duct, for we have had of late a series of cases very desperately ill, and so transformed by their emaciation and discoloration, and so feeble in body and mind, that I could hardly picture to myself the various stages of metamorphosis toward convalescence. Every one has seen a patient whose life has been despaired of convalesce from acute disease; they watched his rapid decline and expected an almost equally rapid recovery; but when the decline has covered a period of five or ten or perhaps twenty years the changes wrought are so great and apparently of such permanent character that the complete restoration to health is the more astonishing. The large cirrhotic liver, the dry slate-yellow skin, the enfeebled intellect, the body emaciated to the last degree, seem at times almost to preclude all hopes of recovery to the practitioner who has not witnessed the changes so quickly brought about by nature as soon as the mechanical obstacles to recovery have been removed by the surgeon. What nature accomplishes without the surgeon's aid in her attempts to rid herself of the obstruction in the gall-passages and to

repair self-inflicted damage is marvelous; but her methods are very crude and attended with much suffering and great danger, immediate and remote. I have, however, in mind at this moment two particularly creditable examples of nature's surgery.

In the first one the gall-passages were shortened to just the length of the two large stones which completely filled them. One occupied the gall-bladder, the other the pancreatic portion of the common duct; the duodenum was not only adherent to the gall-bladder, but served in place of its anterior wall, which had been destroyed; the stone in the gall-bladder, therefore, rested on the wall of the duodenum, which was pasted, so to speak, over the great hole in the front wall of the bladder. There was nothing that could be called cystic duct; the choleductus was almost completely covered by the duodenum; the hepatic duct was much distended, admitting easily one finger. All signs of inflammation, except its results, had disappeared. The simplest conditions had been produced, and those most favorable to the expulsion of the stones in some subsequent attack; gall-bladder and common duct were reduced to a short, wide, nearly straight tube, which bore a striking resemblance to an atheromatous aorta. The stone in the common duct was behind the duodenum and buried in its wall.

* Read at a Meeting of the Surgical Section of the Suffolk District Medical Society, May 3, 1899.

The second patient had his first colic twenty-one years before admission to the hospital. He was never jaundiced. In the third attack, which began one month prior to operation, his temperature reached 106°. A physician aspirated pus from the distended gall-bladder about twenty-four days after the onset of the third attack, or three or four days before we operated. The gall-bladder was opened in two acts. The fluid in the gall-bladder was almost clear and not bile-stained. Diagnosis: Stone in the cystic duct. Cover-slips showed few bacilli. Cultures yielded bacillus coli communis, pure. Patient applied for re-admission in eighteen months, because he had noticed a hard body just beneath the skin in the mouth of the sinus. By simply dilating the sinus I removed four large, very dark-green, almost perfectly cylindrical stones, which were piled up upon each other in this sinus, forming a column 10 centimeters high. Nature would herself have extruded these stones which she had brought to the surface without causing the patient any discomfort.

Equally marvelous are the processes by which nature destroys all traces of her surgical handiwork. I have operated upon two cases in which perforation of the gall-passages and intestinal walls, and the expulsion of the stone, had undoubtedly occurred, but was unable in one of them to find any evidence of the perforation other than a few light and easily separable adhesions. Again, in a case of appendicitis, followed by gangrene of the greater part of the cecum and a wide preternatural anus, there were, within a year, only a few very light adhesions about a pinhole opening in the colon to tell the story. These facts are enough to make the ordinary operations for suspension of the spleen, liver, uterus, etc., seem ridiculous. Adhesions about an artificial opening fortunately never disappear. If innocent fistulæ could be established, with the organs to be suspended, the problem might in a way be solved.

I wish to ask your attention to-night to a few of the unusual facts observed by us in our operations upon the bile-passages, particularly the common bile-duct. Almost every one of our common duct cases has presented us with a new fact or two which can hardly fail to interest the general practitioner, as well as those who concern themselves with the surgery of the bile-passages. To be as brief as possible, for the time is short, I will summarize at the outset some of the more noteworthy incidents observed by us in this department of surgery.

I. Dilatation of the first part of the duodenum caused by constricting adhesions; as the result, perhaps, of the dilatation, an ulcer ("distention ulcer"—Kocher) on the confines of the pylorus; the ulcer gave rise to a dissecting submucous abscess (chronic), rich in organisms because not reached by the most painstaking sterilization of the stomach. This abscess was punctured during the operation and a fatal peritonitis resulted (terminal infection), although, literally, only a drop or two escaped, and these were carefully wiped away.

II. Primary carcinoma of the duodenal papilla and diverticulum Vateri.

First operation.—Excision of portions of the duodenum (nearly its entire circumference), pancreas, common bile-duct and pancreatic duct in order to give the little growth, no larger than a pea, a wide berth; circular suture of the duodenum and

transplantation of the stumps of the common duct and the pancreatic duct (Wirsung's) into the line of this suture.

Second operation.—Cholecystcysticoenterostomy by the writer's method* for intestinal lateral anastomosis.

III. Dynamic dilatation of the first portion of the duodenum and of the pyloric portion of the stomach, corresponding accurately to the limits of a sharply-circumscribed peritonitis; gall-stones in the gall-bladder; hydrops vesicæ. Case full of interest for diagnostician. Beautiful instance of circumscribed dynamic dilatation caused by local inflammation; no adhesions.

IV. Conditions suggesting hepaticocholecystostenterostomy (hepaticocholecystostcholecystenterostomy) as a possible operation; common and cystic ducts reduced to fibrous cords; dilated hepatic duct and gall-bladder. Remarkable toxic (?) renal colic resembling closely intestinal colic, associated with anuria; colic and anuria entirely relieved by salt infusion.

V. Choledochotomy performed twice. The gall-bladder, which was shriveled at the first operation when two stones were probably in the common duct, was large and distended at the second operation when only one stone occupied the common duct (the ampulla). Hematemesis after the second operation.

VI. The densest adhesions that I have ever encountered in these operations, and probably the most difficult of my operations upon the bile passages. A small abscess in the midst of the adhesions; muscular coat of the duodenum converted into fibrous tissue; the exposed submucosa resembled gall-bladder so closely that the duodenum was aspirated and opened.

VII. Case illustrating the rapidity with which adhesions after perforation and extrusion of stone can be absorbed. Renal pains resembling intestinal colic (third observation of the kind within eighteen months). Tachycardia, believed to be due to toxemia of some kind (possibly benign embolism), suddenly disappeared during counting of pulse and while preparations were being made for subcutaneous infusion.

VIII. Discharge of pus and blood by mouth and rectum during severe gall-stone attack. Two years later, adhesions so extensive and so dense that the common duct was reached by a retroperitoneal route, over the right kidney. A stone in the ampulla had just ulcerated through the wall of the common duct and through its duodenal coverings.

CASE I.—*Duodenal stenosis from gall-stones; dilatation of the stomach and of the pyloric end of the duodenum; duodenal ulcer giving rise to a dissecting abscess.*—J. S., age thirty-six, admitted February 5, 1899. Never had typhoid fever. Had malarial fever ten years ago with shaking chills. Never suffered from stomach trouble until present illness. Ever since he was eight years old has had sick headaches, lasting three to four hours, once a month; these would be relieved by emptying his stomach. Has never been jaundiced nor had clay-colored stools. Present illness began very gradually. Three years ago, he noticed that his stomach would swell after eating and hardly regain its normal size before the next meal. Had more or less pain in the epigastrium, which was most marked about one hour after eating. No nausea or vomiting at first; bowels regular. About the first of last October the pain became worse, and his sick headaches were more numerous and more severe. His vomiting now began. The vomiting was accompanied by colic, so severe as to double him up. Patient was obliged to stop

* BULLETIN of the Johns Hopkins Hospital, No. 10, 1891.

work for two weeks. He then resumed work until Christmas, since which time he has been unable to work. Patient now vomits much more frequently. The vomiting is preceded by heartburn for about three hours and much pain in the epigastrium. Patient feels greatly relieved after the vomiting. For two weeks after Christmas he had eructations of gas; none since then. Bowels usually constipated; sometimes did not move for three weeks. He still suffers much from headache. His appetite is good, but he is afraid to eat. In October, 1898, patient weighed one hundred and forty-five pounds; he now weighs one hundred and twenty-three pounds, and is very weak. Neither stools nor vomitus have ever been blood-stained. Urine normal. Stools clay-colored. Patient not jaundiced.

On palpation of the abdomen no distinct tumor can be felt, but one detects an increased resistance just to the right of the umbilicus. The stomach's longest diameter is 31 cm.; its shortest diameter, 21 cm. The lowest limit of the stomach (tympanitic) is $3\frac{1}{2}$ cm. below the umbilicus. Spleen not palpable. Heart and lungs normal. Glands nowhere enlarged. Pulse slow, feeble, 60 beats to the minute.

January 24th. Test breakfast (Ewald). Two hundred and sixty cc. removed one hour later; green color; acid. Total acidity, 5.9 cc.; 0.1 normal NaOH. Free hydrochloric acid; no lactic acid. No *sarcinae* nor Oppenheimer bacilli.

February 4th. Test breakfast. Sixty cc. removed. Total acidity, 20. No hydrochloric acid; no lactic acid. A few Oppenheimer bacilli (?).

February 5th. Stomach tympanitic. Clapnetage readily obtained. Stomach peristalsis quite marked at times. Gurgling felt over small intestines. Stomach washing with sterile salt solution, as preparation for operation, begun. Stomach holds about two liters. Cover-slip preparations show streptococci and staphylococci and numerous bacilli.

February 7th. Stomach washing continued. Cultures taken from the residual material. Cover-slips show only a few streptococci in short chains; number much decreased since February 5th.

February 8th. Only a trace of free hydrochloric acid; no lactic acid. Total acidity, 6.2 cc., 0.1 NaOH solution. Stomach peristalsis readily seen at times. Patient has been kept on sterile diet ever since his transfer to the surgical side. Has carbolic-acid gargle three times daily. Teeth cleansed three times daily with listerine and brush. Ingesta are boiled water, boiled milk, soft-boiled eggs, albumin. Micro-organisms seem to have entirely disappeared from the stomach, for the Petri plates are now sterile. Patient has shown great irregularity in amount of hydrochloric acid—at one time five per cent., at another zero.

February 9th. *Operation*.—Vertical incision through left rectus. This incision was made with the expectation of a possible gastro-enterostomy. Stomach much dilated. In the region of the gall-bladder is a mass of tissue tangled by dense adhesions. In this mass are gall-bladder and pylorus. The mass feels not unlike a new growth. Search for metastases negative, but a small, hard, dark tumor, the size of a pea, is discovered in the right lobe of the liver, near its edge, evidently an angiosarcoma. Pylorus separated from gall-bladder with the greatest difficulty. The separation had to be effected with the knife. It was impossible at first to determine accurately the relations of the gall-bladder, pylorus and duodenum to each other. In the course of the dissection a pinhole opening was made in what proved to be the duodenum. The surrounding parts had been well protected against such an accident. A drop of fluid escaped, and from these cultures were taken. The little hole was immediately sutured. The gall-bladder was next opened, and not until then could it be determined positively that the pinhole opening was not in the gall-bladder, the contents of duodenum and gall-bladder so closely resembled each other; it was a thick, ropy, mucoid, colorless material. The gall-bladder was finally completely isolated. It was small and misshapen and

contained two or three hard mulberry-like gall-stones. The cystic duct contained no stones and seemed to be very short and very fine. It was surrounded by numerous small vessels, two of which were tied. There was no bile in the freely opened gall-bladder, which was drained in the usual way with a rubber tube, a catgut purse-string suture sealing the bladder hermetically about the tube. Bismuth gauze was packed about the outside of the gall-bladder. The peritoneum was closed with silk; the muscles, fascia and skin with silver. Patient bore the operation very well. At 6 p. m., temperature 101°; respirations quiet and regular. Some distention of upper abdomen.

February 10th. Patient has been vomiting. Complaints of pains in stomach and tightness across abdomen. Pulse 108 and feeble; respirations 24; temperature 101°. Leucocytes at 12.30 p. m., 26,800; at 1.30 p. m., 34,000; 5.30 p. m., 36,000; 7 p. m., 37,800. At 6 p. m. patient drowsy, quiet; respirations, 34; hands cold; pulse barely perceptible. Cover-slips show no micro-organisms in the blood. Five hundred cc. salt solution infused under each breast. At 10 p. m. 1000 cc. salt solution infused under breasts. Pulse improved, 140 to minute; low tension but regular rhythm. Respirations 36; expirations accompanied by short groans. Occasional hiccup; no vomiting; no nausea; no pain.

February 11th, 2.15 a. m. Patient died quietly.

Autopsy.—General peritonitis. Organisms, streptococcus pure. In the walls of the first portion of the duodenum, very near the pylorus, was an accumulation of thin mucopurulent fluid. This was held in bounds by a soft wall of granulations; it was evidently an old abscess between mucosa and submucosa, which communicated with the lumen of the duodenum by a fine opening. A minute ulcer had perhaps been the starting point.

The first portion of the duodenum was distended, and the stomach was dilated; the distention was due to the constriction produced by the adhesions, for which the gall-stones were responsible; as a consequence, perhaps, of the distention and the resulting venous stasis, a minute duodenal ulcer; and from the ulcer, the abscess, which was probably responsible for the fatal streptococcus peritonitis.

Of special interest in this case is: (1) the fact that carcinoma had been suspected—the duodenal stenosis, the dilatation of the stomach, the presence of Oppenheimer bacilli (?) justified the suspicion; (2) the success which attended Dr. Cushing's efforts to sterilize the stomach; the micro-organisms had apparently entirely disappeared from the stomach on the day preceding the operation, for the Petri plates, which from day to day showed fewer colonies, for that day were sterile; (3) the dissecting intramural abscess, starting probably from an ulcer which may have been due to thrombosis of a small artery, or to distention of the first part of the duodenum, or to vascular disturbances of some kind, infectious or mechanical. Although thrombosis of a small intestinal artery does not lead to infarction it may cause hemorrhages into the lumen of the intestine and slight intramural extravasations.*

Kocher† has demonstrated that in consequence of distention of the gut by retention of its contents and the resulting venous stasis, very considerable changes take place in the wall of the intestine. He writes as follows: "Arnd has proved that in strangulated hernias, when the circulation is greatly interfered with, micro-organisms make their way into the mucous mem-

* Archiv für pathol. Anat. u. Physiol., 1875.

† Kocher: Mittheilungen aus den Grenzgebieten der Medizin und Chirurgie, Bd. iv, Heft 2, 1898.

brane and can pass through the intestinal wall (diapedesis of the micro-organisms). On the other hand, Cassin* and Charrin† have shown how very important the normal epithelium of the intestine is as a protection to the intestinal wall against micro-organisms as well as ferments. The absence of this protection against ferments and bacteria leads to intoxication and infection. Finally, Reichel‡ has demonstrated that the considerable accumulation of fluid above the site of the obstruction is due in part to a hypersecretion of the mucous glands. Under the influence of the intestinal contents which, increased in amount and stagnating, are the more rapidly decomposing (the oftentimes considerable phenoluria and indicanuria is proof of the increased decomposition), the epithelium in the first place becomes destroyed because its nutrition is interfered with under the influence of the venous stasis. There result circumscribed necroses and hence ulcerations of mucous membrane, particularly in places where the venous stasis led to ecchymosis, and, finally, perforation of the serosa and peritonitis may occur. For the origin of these ulcers which, many times observed, have not been properly estimated in their relations to ileus, various explanations have been given. The most substantial explanation is the one which attributes them to the pressure of hard scybala, and it is not to be doubted that hardened fecal matter, just as foreign bodies—gall-stones, for example—can have pressure ulcers as a consequence. But the ulcers which we have pictured are certainly not dependent upon hard intestinal contents and the decubitus which they may mechanically bring about. They occur in jejunum and ileum as well as in colon by the filling up of these intestines with fluid or gas. The only factor which constantly accompanies these ulcers is overdilatation of the intestine. Inasmuch as one can experimentally bring about a significant impairment of the circulation of the intestinal wall and its consequences, by overstretching of the gut, we hold to the proposition that the ulcers are best called distention-ulcers (*Dehnungageschwüre*). Long ago I called attention to the fact that ulcers of just this kind could also in cases of strangulated hernia lead to a fatal peritonitis after constriction had been relieved, or a gangrenous loop of intestine had been resected and an entirely trustworthy suture had been made.”

CASE II.—*Primary carcinoma of the duodenal papilla and diverticulum of the Vater, successfully removed by operation; cystico-enterostomy three months after the first operation.*—Mrs. M. L., age sixty. Until August, 1897, patient was well. Her first symptom was itching of the skin, which came on suddenly and soon became severe. Patient says jaundice did not appear for nearly a month after the onset of the itching. Before the appearance of jaundice diarrhea set in, and there were six or seven stools a day which were watery and clay-colored. Patient has had no chills, no fever and no sweating. With the onset of the jaundice she noticed shortness of breath and an occasional swelling of the feet and legs. About the first of January, 1898, she had persistent bleeding of the gums for three days, following the extraction of a tooth. At times the hemorrhage was profuse.

* Mittheilungen aus Kliniken der Schweiz, Basel, 1898.

† Fonctions protectrices de la muqueuse intestinale, Soc. de biologie, December, 1895.

‡ Zur Pathologie der Ileus, Deutsche Zeitschrift für Chirurgie.

Two months ago a tumor was noticed in the region of the gall-bladder. This tumor does not seem to the patient to have increased in size and has never been tender. In March, 1897, she had several attacks of severe pain in the epigastrium. These attacks were not accompanied by vomiting or fever or sweating. A few weeks later she had a second but milder attack. The stools were light in color for two or three days at the beginning of these attacks, but patient recalls no change in the color of the urine or the skin at that time. The daughter of the patient states that these attacks of pain were very severe, and that her mother seemed very ill.

Examination February 14, 1898.—Patient somewhat emaciated, but fairly well-nourished. Mucous membranes pale. Heart and lungs normal. There is a distinct prominence on the right side, the highest point of which is midway between the umbilicus and anterior superior spine. The prominence descends markedly with inspiration. On palpation the prominent area proves to be pear-shaped and distinctly fluctuating. The border of the liver, which reaches almost to the crest of the ileum, can be distinctly felt.

February 14, 1898. *Operation.*—Vertical incision through rectus muscle. A greatly dilated but not especially dense gall-bladder presented no adhesions. Liver projects five cm. below costal margin. Four silk sutures* placed in fundus of gall-bladder with French needles. Small aspirator introduced in center, between sutures; syringe of clear fluid withdrawn. Gall-bladder opened; contents evacuated. In the latter part of the fluid were many fine, sand-like, hard, greenish, round particles, suggesting miniature gall-stones. Common and cystic ducts were dilated to the size of one's thumb. A longitudinal opening two cm. long was made in the common duct. The same colorless fluid escaped from this incision. Duct explored with probe and finger. What seems to be a small, very hard stone is felt at site of ampulla. To determine the nature of this body, an incision was made through the wall of the duodenum. No glandular metastases discoverable. The stone-like body proved to be, as was feared, a carcinoma of the papilla.

Excision of the cancerous growth.—To give the growth a wide margin, a large piece of duodenum was excised, a wedge-shaped piece with the apex at the mesenteric border of the intestine. About three-quarters of an inch of the common duct and a shorter piece of the pancreatic duct were excised. The wound in the duodenum was closed in the usual way with mattress sutures. This was practically an end-to-end anastomosis of the duodenum. The common duct and pancreatic duct were transplanted into the duodenum along the line of suture. A linear incision into the common duct, which had been made for diagnostic purposes, was closed over a hammer. The gall-bladder was sutured to the peritoneum.

Abdominal wound closed in the usual way; the peritoneum with a running silk suture, the muscles and fascia with buried silver sutures, and the skin with a continuous subcuticular silver suture. Bismuth gauze inserted to protect the suture of the intestine and common duct. Drainage tube surrounded by bismuth gauze, and gutta-percha tissue inserted into gall-bladder and held in place by a purse-string suture of catgut. Wound dressed with silver foil. Gutta-percha tissue placed between the raw edges of the skin and the gauze packing. Operation lasted three hours and ten minutes. Patient experienced apparently no shock from the operation.

February 16, 1898, first dressing. Profuse discharge of bile in dressing. Icterus less intense. Considerable abdominal distention, but no signs of peritonitis.

* We find this a very useful procedure. The gall-bladder is manipulated by these sutures and handling is thus avoided. These sutures are of additional service when it seems advisable to distend, subsequently, the gall-bladder with fluid, and when it is desirable to close it temporarily during the operation.

February 18, 1898. Distention has almost completely disappeared. Tongue clean. Patient comfortable.

February 22nd. Discharge of bile into dressings still profuse. Stools becoming distinctly bile-stained. Icterus rapidly disappearing. Urine dark and gives bile reaction. Patient hungry.

February 27th. Skin sutures, tube from gall-bladder and the last of the bismuth gauze removed. Evacuations not bile-stained.

March 4th. Discharge of bile diminishing. Opening in gall-bladder has been plugged for several days with bismuth gauze in order to determine, if possible, whether or not the transplanted common duct is patulous. Yesterday patient vomited 125 cc. of brownish fluid.

March 5th. Patient has had a large stool, quite dark in color. There is very little leakage from the opening into the gall-bladder, which is almost closed.

March 13th. Icterus continues undiminished. Stools are still slightly bile-stained. Abdomen somewhat distended. Active peristalsis is occasionally visible through the abdominal walls. Liver still readily palpable, the right lobe extending almost to the iliac crest. Appetite good; tongue clean; no indigestion.

March 27th. Attempts to plug the opening of the gall-bladder, with the hope of forcing bile into the intestine, not satisfactory, although there is some bile in the stools. Patient's general health good. Icterus has disappeared. Patient able to walk about, and is gaining strength rapidly.

April 5th. The conjunctivæ are clear, but there remains still some evidence of bile pigment in the skin. No bile whatever in the stools, although the opening into the gall-bladder is almost closed; it is barely large enough to admit a probe. Patient is beginning to have indigestion. The appetite as a rule, however, is good. The liver is diminished in size.

April 8th. Patient complains of colic and abdominal pain. Considerable abdominal distention. Dressings bile-stained. No nausea; tongue is clear.

April 12th. Some nausea and vomiting. No distention of abdomen. Dressings very slightly bile-stained.

April 15th. Abdomen soft and relaxed, but borborygmi heard by attendant and appreciated by patient. Little or no bile in dressings.

May 5th. *Second operation: cholecystoduodenostomy, or cysticoduodenostomy.*—Suture of fundus of gall-bladder. Complete closure of abdominal wound except for drainage. Incision alongside of old cicatrix, circumscribing fistula. Gall-bladder quite small, no larger than one's thumb. Liver about normal in size. Many fine adhesions about gall-bladder, which were easily separated. Gall-bladder and ducts thoroughly exposed. The line of suture of common duct at previous operation was readily distinguishable by black-silk stitches, but it was almost impossible to find any trace of the duodenal suture. Common duct incised at site of old suture. Probe cannot be passed into the duodenum, but there is no positive evidence of the recurrence of the cancer. Unsuccessful attempts had been made before the operation to pass a probe from the gall-bladder through the common duct into the duodenum. Opening into the common duct closed in the usual way with mattress sutures over hammer. An anastomosis between duodenum and the gall-bladder or cystic duct was effected without much difficulty, although the parts to be sutured were very deeply situated and inaccessible. The duodenum was probably a little less freely movable than at the previous operation, and the gall-bladder was so much reduced in size that we were compelled to pass some of the stitches into what seemed to be the cystic duct; in any event, the neck of the gall-bladder had to be used for the anastomosis. A *bougie à boule*, passed into the gall-bladder, was used as a darning ball to assist in the placing of the sutures. All the sutures were passed (none of them tied) before the openings into the neck of the gall-bladder and duodenum were made, the method employed being that which I described many years

ago for intestinal anastomosis. The opening in the fundus of the gall-bladder was closed with mattress sutures which inverted the wall. The abdominal wound was completely closed except for protective wicks which were passed through this line of suture into the gall-bladder. What seemed to be an enlarged gland was palpated during the operation but not removed; it was forgotten. Patient suffered little or no shock from the operation.

May 6th, 4.30 p. m. Patient very restless, tossing about and occasionally vomiting. Ten p. m., has had occasional quiet naps and is more comfortable.

May 7th. Complains of pain in back and abdomen.

May 8th. Is very comfortable. Yellow stool, containing small particles of brown fecal matter.

May 9th. Large greenish-yellow stool.

May 11th. Patient has had daily, since last note, one or two greenish-yellow soft stools. She still complains of slight pain in abdomen.

May 12th. A large, quite well-formed greenish-brown stool. Considerable flatus expelled; complains of gas in stomach. Slight nausea. Four p. m., vomited thick, mucus-like, chocolate-colored fluid containing milky curd.

May 29th. Patient complains of itching in the hands where the pruritus has always been the greatest when icterus was pronounced. No jaundice, however, is apparent.

June 8th. Slight chill, followed by rise of temperature to 39°. Trace of bile in the urine. Nausea, but no vomiting. No pain and scarcely any tenderness of the abdomen. Wound almost completely closed.

June 9th. Temperature normal; patient feels well.

In the early autumn of 1898 this patient returned to the hospital too ill for operative interference, and in a few weeks died. During the summer I had corresponded with her, urging her to return to the hospital, for it was clear from her letters that the fistulous communication between the gall-bladder and the duodenum was not working well. At the autopsy it was found that the carcinoma had recurred in the head of the pancreas and duodenum closing the common duct and interfering with the perfect action of the cholecystenterostomy, or cystico-enterostomy. The anastomosis, as we had supposed, had been made between the dilated cystic duct and the duodenum; the fistula was still perfectly pervious and should have acted nicely except for the interference, a little twisting or bending, created by the new growth.

The result in this case is not encouraging, for it was my opinion at the time of the operation that the case could not have been more favorable. But I did in this case what I never do if it can be avoided, namely, cut well down to or perhaps a little way into the new growth for the sake of diagnosis. It is furthermore a rule in my clinic that pieces shall not be excised from new growths *in vivo* for diagnostic purposes; we must learn to make the diagnosis in other ways. In the case of a very small breast tumor it is occasionally impossible to make the diagnosis before operation. I have sometimes approached the tumor with the knife very cautiously, and could tell before I reached the growth, from the findings in the outlying tissues, whether we had a malignant tumor to deal with or not. I shall have more to say about this at another time, but I feel that one cannot condemn too strongly the universal practice of exploring tumors with the knife or with the harpoon or even with the needle. After investigating the subject superficially, I have the impression that amputations for the truly malignant

sarcomata have comparatively seldom been successful when preliminary exploration has been done. If I find it necessary to make an incision into a sarcoma of an extremity, I first apply an Esmarch bandage, and if the tumor is a malignant growth, the bandage is not removed until the growth has been removed. So, too, in cysts of the breast; we should not aspirate them, because (1) they may be malignant and the aspiration harmful, and (2) if malignant, the aspiration does not tell us so. This is the first and I believe the only instance in which an operation for primary carcinoma of the duodenal papilla has been done; moreover, I know of no other case of excision of a portion of the common duct. Heidenhain* (Worms) demonstrated last year at the twenty-seventh Congress of German Surgeons, a shriveled gall-bladder which he had removed for a small cancer of its wall; after extracting six calculi from the bladder, a little button-like prominence on its wall caught his eye. The microscopical examination showed little or no thickening of the mucous membrane, but unmistakable alveoli in the muscular wall of the gall-bladder; furthermore, some of the lymph-vessels were plugged with cancer cells. In three months the patient succumbed to liver-cancer which had attained great dimensions, although at the time of the operation the liver was apparently perfectly normal. At the same session Hollander† (Berlin) reported an extirpation of the gall-bladder and cystic duct and resection of a portion of the liver for cancer, which *per continuitatem* involved the liver. The result he could not give, for he had performed the operation only three weeks before. There can be little doubt as to the ultimate result of Hollander's operation, although, having operated only three weeks previous to his report, he could not give it.

CASE III.—*Dynamic or paralytic dilatation of first portion of duodenum and of the pyloric end of the stomach corresponding accurately to the limits of a sharply circumscribed peritonitis. Gall-stones in gall-bladder and cystic duct. Obstruction of cystic duct and hydrops vesicae.*—Mrs. S. G. M., age forty six. Admitted January 31, 1899. Never had typhoid fever. Headaches at intervals all her life, sometimes very severe and lasting several days; especially severe during menstruation. Digestion has been bad for sixteen years. After meals a heavy feeling in epigastrium followed by fullness and a feeling of suffocation. Belching of gas common; occasionally would regurgitate a mouthful or two of food. Rarely vomited; never any blood in vomitus. Bowels generally constipated. Micturition frequent, occasionally twenty times a day; generally several times at night. Menses regular. Average weight, one hundred and fifteen pounds. Has lost in weight of late. Present illness, patient states, began December 31, 1898, although she was much run down before that time. This attack came on gradually. Some distention of stomach, and in the afternoon some pain which became severe at night. The pain was in the epigastrium—a colicky pain—which, as she expressed it “went through the abdomen.” Morphia exhibited. Next morning patient felt easier. Morphia continued for next two days. Pain relieved but not entirely subdued. Stools after this were very black, like tar. Physician found something in the stools which he thought might possibly be a gall-stone. Since this attack patient has never been well; constantly in bed. Great deal of soreness through abdomen, and at times attacks of colic. These

attacks usually came on in the evening without known cause. Much belching of gas. Bowels regular. Stools not clay-colored. No jaundice. Patient's daughter states that for many years her mother has had attacks of abdominal pain, for which the doctor gave morphia hypodermically. There were intervals of several months between the attacks.

Examination.—On palpation no tenderness except beneath the right costal margin. Here there is to be felt a rounded mass resembling a distended gall-bladder. Right rectus muscle very hard. The mass which is to be felt at the outer edge of this muscle seems lobulated.

January 29th. Attack of what patient calls “colic.” She is nervous and distressed, and complains of abdominal pain. Swallows air and belches it up again.

January 31st. Transferred to surgical side. On inspection a distended piece of gut between umbilicus and tumor, extending obliquely from the left and above to the right and below, probably six or eight inches in length. Peristalsis is to be observed at intervals; it is not very active, but at times is quite constant. A tumor suggesting gall-bladder projects from the lower border of the liver. It seems to be nodular, or rather has a nodule on it at its upper part. This tumor descends with respiration, and is somewhat tender. The edge of the liver can be felt on each side of the tumor.

February 3d. *Operation.*—Vertical incision through right rectus muscle. No fluid in abdomen. Gall-bladder distended to size shown in diagram on blackboard. Its walls were thickened and white. The first portion of the duodenum and the pyloric end of the stomach were distinctly distended. Corresponding accurately to the distended portion of the bowel was a slight peritonitis, scarcely more than an injection of the serosa, and an exudate, only enough to cause very fresh adhesions between the duodenum and the gall-bladder. We should hardly call them adhesions; the duodenum seemed rather to be lightly glued to the gall-bladder just as it might be an hour or two after an operation.

I was extremely interested to find that the vascular injection seemed to correspond accurately to the limits of the dilatation (almost ileus at times). The adhesions, if we choose to call them such, were so fresh that they were separated by very slight pressure of the finger. The general abdomen being walled off by gauze packing, the gall-bladder was opened. Its contents were colorless and in consistency like the white of an egg. Cover-slips were negative. First, one large gall-stone was found with a facet at each end. Then a second stone was detected with a probe in the cystic duct, but it could not be dislodged. Cysticotomy was performed and the stone removed in fragments. The previous attempts to dislodge it had evidently broken up the stone. Incision in cystic duct closed by mattress sutures. Gall-bladder treated in the usual way, namely, hermetically sealed about a rubber tube and protected by bismuth gauze, from the general peritoneal cavity. Abdominal wound closed in the usual way.

At first no bile escaped by the tube, but on the 10th of February, bile was abundant in the dressings.

March 2d. Wound has completely healed. Patient discharged cured.

Various diagnoses had been made in this case: (a) distended gall-bladder with adhesions; (b) cancer of bile-ducts and liver, involving secondarily the colon; (c) carcinoma of the colon, involving secondarily the gall-bladder and gall-ducts. The distended intestine I watched with much interest several times. It seemed to me too small for colon: and no mass could be felt in the distal side of the distended gut to explain the distention. Peritonitis is undoubtedly the most common cause of paralytic ileus, and I have repeatedly observed in appendicitis that dilatation of the cecum and of the ileum may

* Heidenhain: Verhandl. d. deutsch. Ges. f. Chirurgie, 1898, p. 126.

† Hollander, l. c. p. 131.

be caused by a very slight, perhaps merely a toxic peritonitis, but I have never before noticed such a sharp line of demarcation between the inflamed and noninflamed portion of the intestine. The dilatation corresponded accurately to the vascular injection. This was the more striking because two portions of intestine so very different were involved. That the comparatively thin wall of the duodenum should be more or less affected by inflammation of its serosa is to be expected, but that such a thick-walled gut as the pylorus and the pyloric end of the stomach should be paralyzed by such a very slight inflammation of the serosa was surprising.

CASE IV.—*Conditions suggesting hepaticocholecystostcholecystenterostomy as a possible operation. Common and cystic ducts reduced to fibrous cords, dilated hepatic duct and gall-bladder. Renal colic stimulating intestinal colic; relieved by salt infusion.*—Mr.——, age sixty, had been suffering from gall-stones for several years, but not until he became persistently icteric and very ill was the first operation performed. The operator, a distinguished surgeon, found most difficult conditions confronting him. The entire common duct was impervious and reduced to a fibrous cord; the cystic duct, greatly narrowed, was probably impervious; the gall-bladder and hepatic ducts were dilated. The surgeon, very skillfully, I am told, attempted to construct a new common duct over a tube or catheter from the tissue which he had at his disposal. Just what these available tissues were I do not quite understand. For about five weeks, and until this tube was removed and the surgeon went away on his vacation, the patient was fairly comfortable and seemed to be gaining a little. Then he developed high daily fever and occasional chills, and became jaundiced again. I saw the patient in consultation with Dr. Gardner, of Providence, about one week, I believe, after the fever and the symptoms of obstruction had manifested themselves. The gall-bladder could not be felt. There was perhaps a little more muscle resistance on the right side over the region of the bile-ducts than on the left side, also perhaps the suggestion, rather indefinite, of a little induration such as might be caused by fresh adhesions. It occurred to me that in case the gall-bladder and hepatic ducts were still both dilated one might establish a fistulous communication between them, making an hepaticocholecystostomy and then, immediately, a cholecystenterostomy; in all an hepaticocholecystostenterostomy. In any event, we thought that an operation for the relief of the symptoms was imperative. Accordingly a vertical incision through the inner margin of the right rectus muscle was made, avoiding the fistulous tract which remained after the withdrawal of the tube over which the new common duct had been constructed. I worked for two hours trying to identify and to separate the parts concerned in this operation. The gall-bladder, the ducts and the duodenum were glued tightly together and to the under surface of the liver. The gall-bladder which was finally extricated from the tangle was very small, contracted and empty; the cystic duct was a fibrous cord. When bile was at last reached the patient was in such bad condition that the operation had to be discontinued. The parts in the neighborhood of the common and hepatic ducts were so firmly matted together that neither the latter nor the remains of the former had been demonstrated when it was necessary to bring the operation to a close.

The patient rallied satisfactorily from the immediate effects of the operation; but twelve or fourteen hours thereafter complained of very severe abdominal pain, which, as he indicated the location of it, seemed to be in the region of the colon and passing from right to left. The pain, though perhaps constant, became excessive during the paroxysms. It was never referred by the patient to his back or sides, nor did it radiate to the testicles or groin or crest or ilium. The abdomen was perfectly flat, and peristalsis could

not be observed. Nevertheless, large high enemata of hot water were given, but without appreciable relief. The urine was scanty and very dark and contained albumin and casts and a few blood-cells. Dr. Gardner promptly attributed the pains to the kidney, and related a somewhat similar case. Believing his interpretation of the pains to be correct and recognizing the fact that something must be done quickly for the relief of the kidneys, I transfused about 750 cc. under the breasts. The pulse, which was alarmingly rapid before the transfusion, dropped 40 beats within thirty minutes, and 20 beats within five minutes, and the colicky abdominal pains disappeared. Within twenty-four hours the infusion was repeated with similar results. The kidneys responded promptly to both infusions.

I report this case because (1) it suggested a new operation, hepaticocholecystostcholecystenterostomy, or hepaticocholecystostenterostomy; (2) it was the first of three cases of colic which I have seen associated with scanty high-colored urine; and (3) it was, so far as I know, the first instance of subcutaneous infusion of salt solution for the relief of toxic renal colic. Soon after this Dr. Young, by salt infusions, undoubtedly saved the life of one of my patients whom I had operated upon for appendicitis, and who was suffering from perhaps the most furiously rapid toxemia that I have ever known of. This case has been reported by Dr. Young in the *Maryland Medical Journal*. The resemblance to intestinal colic is so great that it would undoubtedly be mistaken for it even by experienced practitioners of medicine. This was a valuable lesson for me, for since then I have twice recognized as renal colic this pain, which had been regarded as intestinal colic and treated with high injections. Our list of desperate cases of toxemia treated advantageously with infusions of salt solution is assuming large proportions.

CASE V.—*Choledochotomy performed twice within four and one-half months. The gall-bladder, small and contracted at the first operation, when two stones were in the common duct, was large and distended when only one stone occupied the common duct (the ampulla).*—Mrs. M. P. R., age fifty-eight, admitted May 3, 1897. October, 1892, patient began to have moderately severe attacks of pain in the region of the gall-bladder. The attacks would come on suddenly and last several hours unless relieved by anodynes. The pain, milder at first, would gradually increase until it became very severe; it commenced in the epigastrium and extended into the right hypochondrium. During the winter of 1892-1893 the attacks occurred every two or three days. Occasionally there would be an interval of two or three weeks. During the remainder of 1893 and all of 1894, the attacks persisted at longer or shorter intervals, the pain always beginning in the epigastrium and radiating to the back. Sometimes during a severe attack there would be slight vomiting. Morphia generally gave relief. Patient says that the attacks were not accompanied by tenderness nor tumefaction. In the attacks observed by me there was always tenderness and, after the first operation, distention of the gall-bladder. In the spring of 1895, she went to Hot Springs, Va., where she remained several months. After this she had no pain for fifteen months, but did not seem to gain or improve in health. In September, 1896, in Italy, the pain returned. The attacks recurred with great regularity for seven or eight weeks. Most of them were attended by nausea and some by vomiting. She became jaundiced for the first time in December, 1896, and has remained more or less icteric until admission. Just after the paroxysms the icteric is deeper. For the past five months she had remained in bed most of the time. She vomits frequently, is seldom free from nausea. The bowels

have not been markedly constipated; appetite is poor; headaches occasional but not severe. Prior to this illness, however, she suffered very much from headaches. At no time has she had chills or sweating.

Examination.—Patient is quite deeply jaundiced; her color is a dark slate-yellow; tongue heavily coated; body much emaciated; expression rather dull, eyes lusterless. Heart not enlarged; no adventitious sounds. Lungs negative. Urine dark, almost coffee-colored, trace of albumin, much bile-stained sediment. A few bile-stained casts and epithelial cells. Red blood-corpuscles, 4,220,000; white, 6,000.

May 4, 1897. *First operation.*—Longitudinal incision through right rectus muscle; resection of cartilages of eighth, ninth and tenth ribs, because the common bile-duct was very inaccessible. Choledochotomy; removal of one small mulberry calculus. Exploration of duct fails to detect a second stone. Suture of duct wound. Gall-bladder atrophied and not opened. Bismuth gauze packing to suture in duct. Peritoneum sutured with fine silk, muscles and fascia with silver wire, and skin with a buried suture of catgut. Little or no shock from the operation.

On opening the abdomen the tissues were bile-stained. There was no fluid in the peritoneal cavity. The outer surface of the contracted gall-bladder was covered with new connective tissue in which were little masses of fat. The omentum was loosely adherent to the gall-bladder. The cystic and common ducts were easily isolated after division of three of the costal cartilages. No stones could be felt in the bladder or cystic duct. The stone found in the common duct could be moved quite freely up and down in this duct, but could be forced into the cystic duct, the common duct, about $1\frac{1}{2}$ cm. in diameter, being uniformly dilated. Bile flowed from it when opened. It was carefully explored with the fingers but not with an instrument. The gall-bladder was not opened. Two mattress sutures closed the opening in the duct, one preliminary suture being taken before the duct was opened. The sutures were passed without difficulty, the wall of the duct being about 3 mm. in thickness. No leakage occurred after the stitches were tied. The calculus, without facets, was spherical, about 1.6 cm. in diameter, and had a granular surface like a mulberry calculus.

May 15th. Patient has recovered uneventfully from the operation. She is easily nauseated, however, and has very little desire for food. The stools have about the color of dark coffee and the skin has become lightened perceptibly. She complains, however, of an aching pain in the back, not relieved by posture.

May 24th. Patient has no inclination to eat; takes almost nothing by mouth. Nutritive enemata, which have been administered uninterruptedly since the operation, are still well borne. About every two days there is quite a definite attack of pain in the umbilical region and back, ushered in by nausea. Vomiting usually follows in a few hours and the distress is relieved.

May 29th. Condition little changed. Patient is fairly comfortable except for the attacks. Takes a little more food. Stools semi-solid and still quite dark. Urine has trace of bile.

June 13th. No bile in urine. Vomitus contains considerable hydrochloric acid.

June 26th. Appetite and digestion have steadily improved. Nausea less constant, often absent. Patient constipated, requires enemata; stools normal as to color.

July 4th. Much more comfortable. Nausea has disappeared; color greatly improved, but the attacks of pain continue, although they are less frequent.

July 13th. Slight chill at 5.30 P. M., accompanied by pain in the back and head. Temperature reached 103° at 7.30 P. M.; fell to 99.2° at 5 A. M. Examination of blood for malaria, negative.

July 25th. Patient has lost one and one-half pounds in weight in the past week. The right lobe of the liver is enlarging. The spleen is palpable. Patient is having short attacks of fever accompanied by slight chills; headache and yawning usually associated

with them. The attacks of pain continue; they are still controlled by very small doses of morphia, one-sixtieth to one-fortieth of a grain. She sits up out of bed most of the time.

July 27th. The pain in the back has of late been accompanied by a slight rise of temperature, 99.2° to 105.5° . The urine contains no bile. The stools consist of light and dark portions sharply separated. Patient is gaining quite rapidly in weight.

August 5th. Stools clay-colored. Temperature reached 102° last night during an attack of pain. Skin is becoming icteric; urine contains bile; slight pruritus. Patient's weight has increased five pounds in ten days. From August 8th to 12th no bile in urine.

Sept. 12th. The attacks of pain and the pyrexia continue. Patient is decidedly icteric after some of the more severe attacks. What we have feared ever since the operation we are now quite certain of, namely, that there is still a stone in the common duct, probably in Vater's diverticulum. The liver is considerably enlarged, but the gall-bladder has not been definitely made out.

September 13th. *Second Operation.*—Vertical incision near linea alba. Adhesions from previous operation separated without much difficulty. Liver much enlarged; gall-bladder and common duct distended with bile. The wall of the common duct was much thicker; the wall of the gall-bladder, on the other hand, was probably thinner than at the previous operation. A small stone was palpated deep down behind the duodenum, presumably in the ampulla. The line of the old suture in the ductus choledochus could not be very definitely made out, but a short yellowish-white streak, evidently cicatricial tissue, corresponded, I thought, to the site of the original slit in the duct. A fine suture was placed in the common duct to serve as a handle for the subsequent manipulations. The duct was opened, and about 60 cc. of clear greenish bile escaped. A gauze plug was inserted into the proximal end of the slit to prevent the stone from slipping into the hepatic duct. Interrupted sutures were taken over a hammer of the proper size. The dislodgment of the stone was somewhat difficult. It was a little smaller than the first stone, but otherwise repeated the original exactly. The gall-bladder was opened, sewed to the peritoneum, and drained in the usual way; a rubber tube surrounded first by gauze and then by protective being held in place by a purse-string suture of catgut. Wicks of bismuth gauze protected the line of suture in the common duct. The operation was attended with very little shock and the patient reacted very well.

Sept. 20th. There has been more or less nausea ever since the operation. Patient objects decidedly to stomach washing. Bile is draining actively from the tube. There has been little or no nausea to-day, but patient is weak and much depressed. The removal of a piece of gauze from the gall-bladder gives patient the first sensation of "heartburn," which she has had since the operation; it lasted several hours.

Sept. 22d. Patient is thin and emaciated and alarmingly weak; speaking is a great exertion to her. Temperature subnormal. There are no wound complications, nor any signs of peritoneal irritation or obstruction. Alimentation is almost exclusively rectal; 6 P. M. vomited 1000 cc. of fluid thick with "coffee grounds." Patient very restless. Examination of vomitus: No bile; blood-corpuscles abundant; altered blood pigment; free hydrochloric acid; no lactic acid.

Sept. 23d. Patient has vomited several times during the day; in all about 2000 cc. of the same dark coffee ground vomitus. The pulse is very feeble.

Sept. 24th, 8 A. M. Pulse barely susceptible early this morning; rallied a little after exhibition of salt solution per rectum. Still vomiting large amounts of same fluid, though nothing is being administered by mouth. 12 M. Patient is very low but still conscious. Infusions of salt solution were given under breast and in buttocks. 5.15 P. M. One drachm of one per cent. solution cocaine given by mouth. 5.30 P. M. Patient vomited 360 cc. of same dark fluid. Cocaine given again. No vomiting since second dose.

Sept. 25th, 1 A. M. Patient responds a little to the saline infusions. She is moaning and restless. Her nose and extremities are cold. She sleeps in short naps, with her eyes open and eyeballs rolled up. Complains greatly of thirst. Champagne and albumin retained and apparently relished.

Sept. 28th. Infusion again soon after midnight. Involuntary stools and small amount of dark vomitus. Is somewhat flighty at times. Pulse is thready, irregular, and cannot be accurately counted. She is sighing and seems almost moribund. Too weak to recognize surroundings or members of the family. About noon to-day I saw the patient for the first time since the third day after the operation, having returned to town as rapidly as possible in response to a telegram sent forty-eight hours ago. Dr. Cushing, house surgeon, who had attended her constantly, day and night, met me at the door of the hospital with the words, "no hope, she is dying." We went to her room; she was cold and almost unconscious; her eyes were open, the eyeballs rolled up; the lower jaw had dropped. She had had more involuntary movements and could retain no nourishment. Her pulse was little better than a flutter and could not be counted. In less than forty-five minutes I returned to the patient and found her pulse 120, and fairly regular in force and rhythm. I doubted my senses when I counted it. She was moreover not so cold, her eyes were not staring, and her lower jaw was raised. A miracle! From that moment her convalescence was uninterrupted. She slept an hour, and on waking looked better than she had in two or three days. For twenty-four hours she was so weak that she could barely move her arms. She remembers nothing that transpired on the 23d, 24th and 25th of September.

In eight weeks, on November 22d, this patient left the hospital, not only able to walk but to take a long journey on the railroad. In one period of seven days she gained nine pounds. Her liver was rapidly diminishing in size.

In April, 1898, I had the pleasure of seeing this patient again. Her color was natural, her digestion excellent, her weight above normal and her strength steadily increasing. Her liver did not extend below the costal margin.

I have seen many cases regarded as hopeless recover, but never a being so near death as this have I known to escape it. I have speculated much as to the possible explanation of the very sudden change in her favor, but it would lead us beyond the limits of this paper to discuss the matter. In toxemias I have noted almost instantaneous drops in the pulse rate. Twice within a month I have observed a fall of 30 beats to the minute follow in less than thirty seconds the opening of an abscess. The abscesses were large and very acute; one was a suppurating laparotomy wound and the other was a circumscribed abscess in the peritoneal cavity. The very instant that the abscesses were opened the change in the pulse was noted. A few months ago we were preparing to infuse with salt solution a patient upon whom I had operated for gall-stones and whose condition gave me not a little anxiety. His respirations were about 40 per minute and his pulse between 130 and 140. The physical signs indicated not very clearly some consolidation of the lower lobe of the right lung. While the instruments were being sterilized for the infusion, and while Dr. Cushing, the house surgeon, was counting the pulse, it fell to less than 100.

Was the hemorrhage from the stomach in the case of Mrs. R. (Case V) due simply to the prolonged vomiting; or to interference with the circulation of the portal vein (liver cirrhosis, pressure of packing); or to thrombosis of a small arterial branch;

or to a retrograde embolism (Recklinghausen,* von Eiselsberg†) or malposition of the pylorus or duodenum? It could hardly have been due to sepsis for there were no signs of infection. As long ago as 1867, Billroth‡ remarked that in septic cases we might have duodenal ulcers and fatal hemorrhages therefrom. He showed in his experiments upon animals that sepsis might cause intestinal hemorrhage, although, in his experience, it seldom did so in man; if, however, there existed an obstruction to the circulation, such as liver cirrhosis causes, little hemorrhages in the stomach plus the action of the gastric juices might lead to the formation of ulcers. The nausea began almost immediately after the operation. Whatever was the cause of this almost continuous nausea and frequent vomiting was also, probably, at least the remote cause of the hemorrhage. Von Eiselsberg has just reported seven cases of stomach and duodenal hemorrhage following operations upon the abdomen. Hematemesis occurred in six of his cases, and never later than the second, usually on the first day. The hemorrhages were demonstrated in three cases post mortem.

In my case the vomiting of "coffee grounds" was not observed until the tenth day. This patient was so carefully watched that I am quite sure that if hematemesis had occurred earlier it would not have been overlooked. In seeking for a common cause for the stomach and duodenal hemorrhages, Von Eiselsberg excludes vomiting because in two cases there was no vomiting, and in two, hematemesis occurred only a single time; he also excludes sepsis because in four of the cases there was no infection, and reaches the conclusion that "If the behavior of the wound is to be regarded as the cause of the hematemesis, then it must be assumed that in the cases which healed by first intention a retrograde embolism from a non-infected thrombus had taken place."

I wish that there was time to discuss this feature of the case more fully, but I must pass on to the consideration of another fact which this remarkable case developed. There were at the first operation almost certainly two stones in the common duct, one in the ampulla, the other more or less freely movable in the duct, although it fitted it quite snugly; but the gall-bladder was small and contracted and not opened, and the liver was little if at all enlarged; the color of the skin was a light slate-yellow or ash-yellow—not the darker bronze-yellow of complete obstruction. At the second operation, however, when there was only one stone in the common duct, the gall-bladder was distended with bile and quite large, and the liver was greatly enlarged, its right lobe almost reaching the crest of the ilium. The patient's color and symptoms indicated that the stone in the ampulla did not at all times obstruct the duct completely. It sounds almost paradoxical to say that the removal of a stone should increase the obstruction, or that the one stone plugged the duct more completely than the two. I believe that a stone in the diverticulum, particularly a small

* Die Störungen des Blutkreislaufes.

† Die Verhandlungen der deutschen Gesellschaft für Chirurgie, 1899.

‡ Ueber Duodenalgeschwüre bei Septicaemia. Wiener med. Wochenschr., 1867.

one, is more likely to block the duct effectually and to lead to distention of the gall-bladder than a stone, however large it may be, elsewhere in the common duct. A stone in the middle of the duct may at first occlude it completely, but the duct wall soon becomes infiltrated and thickened, it loses its elasticity, and, when distended with bile, stretches. The stone no longer plugs the duct tightly and bile trickles by into the intestine even when a second stone occupies the diverticulum, but when the proximal stone is removed, the bile instead of trickling up to the distal stone is probably jetted against it with sufficient force to hold it as a ball-valve. Furthermore, dilatation should not occur so readily in the portion of the common duct protected by the duodenal wall as in the free portion. In 1885 I operated upon a patient whose common duct contained a stone larger than the largest pecan-nut; at times one half of this stone projected into the duodenum, the other half occupied the duct; a flange had been cut on the calculus by the cicatricial ring, which engaged it and prevented it from slipping into the intestine; and yet this patient was so very slightly jaundiced that a stone in the common duct had not been suspected.

CASE VI. Miss M. H., age thirty. Transferred to surgical from medical side, January 27, 1896. Indigestion for eight years. For past four years the "gastric distress" has been very great. Patient describes a "gnawing sensation" in the epigastrium. Colicky pains radiated throughout thorax, but were at times very severe "in the back." Two years ago she had typhoid fever. For the past six months she has had frequent definite sharp gall-stone attacks with nausea, and four times with vomiting. Never blood in the vomitus. No chills, fever nor jaundice. Patient is a confirmed invalid. She suffers from headache and occasionally from vertigo.

Examination.—Abdomen flat. On deep inspiration spheroidal tumor is to be seen just below the costal margin on the right side. This tumor can also be felt. It moves with the enlarged liver, ascending and descending with the respirations. Last September patient first began to have attacks of pain in right hypogastrium, and accompanied by nausea and sometimes by vomiting. Spleen not palpable. The severe pain suffered by patient could be relieved by drawing up the knees. This pain radiated to the right shoulder-blade.

January 28, 1896. *Operation.*—Cholecystostomy. Vertical incision through the right rectus muscle. Elongated right lobe of liver. Very dense fibrous adhesions between the gall-bladder and duodenum. These adhesions were divided with great difficulty, and finally what appeared to be gall-bladder presented. It was aspirated, and a thick greenish fluid withdrawn. It was consequently opened with some confidence, but proved to be duodenum. It was sutured again at once, the suturing being very difficult because the muscular coat had been separated from the submucous coat during the dissection of the adhesions. The muscular coat, owing to the chronic inflammation which had existed for so many years, had become sufficiently fibrous to resemble cicatricial tissue, and consequently was unintentionally stripped from the submucosa. When the submucosa presented, it did so in the form of a little knob-like bladder, this coat resembling almost precisely the wall of the gall-bladder. The gall-bladder was finally found, deeply imbedded in adhesions, almost four cm. to the right of its usual position and far under the enlarged liver. It was opened, and one large oval stone, two cm. by one cm., removed. In the course of the operation a small abscess was discovered in the midst of the adhesions. Patient's recovery was considerably retarded by digestion disturbances, which finally disappeared completely.

April, 1899. Patient says that she is in robust health and wishes to become a masseuse.

CASE VII. The history of this case cannot be published at present.

CASE VIII. *Discharge of pus and blood by mouth and rectum during severe gall-stone attack. Two years later adhesions so extensive and so dense that the common duct was reached by a retroperitoneal route, over the right kidney.*—Mrs. M., age thirty-five. Admitted March, 1895. No typhoid fever. First attack of gall-stones, six years ago, began with sharp attack of pain in the right side of the abdomen. Two years ago miscarriage at seventh month; was ill in bed thereafter four months. While in bed patient had great pain in region of gall-bladder, with high fever, for ten weeks; was continually blistered over liver. Eight weeks after the abortion she felt suddenly something "give way"; this giving way was followed by great relief, and by horribly offensive discharge of pus and blood from the rectum and mouth. These discharges were irritating, gave her a very sore throat and mouth. She spat blood and matter for two or three weeks, and the stools during this time were very offensive. She has had pain and tenderness constantly, with occasionally severe attacks since that time; has been jaundiced more or less ever since, but more markedly so since last July. On admission, body jaundiced and greatly emaciated; tenderness over the entire abdomen, especially in the region of the gall-bladder. Liver, in deep inspirations, extends two fingers' breadth below costal margin, and has a fairly sharp edge. Spleen palpable; stools acholic.

March 19, 1895.—*Operation.* Liver small, barely reaches costal margin; its high position complicated the operation. Colon adherent to liver by rather loose bands; gall-bladder exposed when these were divided. It was high up under the liver and no larger than the tip of the little finger; it was not opened. Adhesions were so dense over the common duct that the peritoneum was opened over the right kidney, and the common duct approached from behind under the peritoneum. A stone being felt, the common duct was the more readily exposed; the stone was extracted through a hole made by ulceration. This hole proved to be at the junction of the duct and the duodenum, and was shut off from the peritoneal cavity by very delicate adhesions. The intestinal part of the opening was closed completely, the duct part as well as possible. The sutures were passed with great difficulty. The opening in the duct could not be completely closed, the tissues being necrotic, and bile escaped through it even after the sutures were drawn tight. Probing of the duct was carefully done. No other stones were found.

October, 1895. Six months after operation, patient is very well, She weighs one hundred pounds.

April, 1899. Examined in my private office: patient still enjoys perfect health; she now weighs one hundred and ninety pounds. Patient states that she has recently given birth to a healthy child.

I report the case of this woman because (1) she was so very ill when operated upon; (2) it is one of the two cases in which intestinal perforation had undoubtedly occurred prior to operation; (3) the common duct was approached in a new way, namely, from behind the peritoneum; (4) the stone, in the ampulla, had ulcerated through the walls of the ductus choledochus and the duodenum, and would perhaps soon have been extruded; (5) the increase in the weight of the patient seemed phenomenal; it was almost doubled within the year following the operation.

What the result to the patient would have been if this stone had ulcerated its way out of the common duct is quite certain, and yet I have several times found stones imbedded in adhe-

sions outside of the bile passages; they were usually close to the gall-bladder. Once I discovered a stone in the wall of a thick-walled gall-bladder; it was completely buried and was causing no disturbance, and was detected in the process of sewing in the drainage tube. This is, I believe, the only case in which I have not divided all of the adhesions encountered. If no contraindication exists, such as necessity for abbreviating

the operation, we should separate the adhesions if possible. The chance of meeting fistulous openings between bile passages and the intestine I regard as an indication for thorough exploration rather than a contraindication to it. Not infrequently adhesions alone are responsible for the symptoms which persist after the calculi have been removed by the surgeon or have escaped in other ways.

EARLY EXPLORATORY OPERATIONS IN TUBERCULOSIS OF THE HIP.*

A PRELIMINARY REPORT.

(From the Clinic of Prof. Halsted, The Johns Hopkins Hospital).

BY JOSEPH C. BLOODGOOD, M.D., *Associate in Surgery.*

I wish to report a case of early operation in tuberculosis of the hip, and am sorry the patient is not here to demonstrate the very happy result.

CASE I.—*Tuberculosis of left hip, of seven weeks' duration. Operation: Capsule distended; tubercular synovitis; small tubercular focus in the neck of the femur. Result, January, 1899 (13 months), perfect. No restriction of motion.*

M. K. Surg. No. 8380. Male, æt. 42 years, butcher by trade, was first admitted to the hospital October 6, 1893, 5 years ago, suffering from tubercular arthritis of the left shoulder joint. The disease of the soft parts and bone was extensive; for this reason excision was performed at once. Although 3 cm. of the shaft of the humerus were removed, the functional use of the arm is an excellent one.

It is of interest to note the possible etiology of the arthritis of the shoulder. This man had always been in excellent health. He could remember no cases of tuberculosis in his family. Eight months ago, he cut his left wrist with a dirty butcher-knife. The wound healed in about one week. One month later he noticed pain in the left shoulder, which was followed by a slight stiffness. The condition was treated for rheumatism. Five weeks ago he noticed a swelling of the upper third of the arm to the inner (medial) side of the biceps muscle.

The patient was readmitted November 30, 1898 (5 years later), complaining of pain and stiffness of the left hip joint. The following are the important facts in the history:

About seven weeks before admission, without any recollection of a traumatism, he experienced, when getting out of bed one morning, pain in the left hip. This pain has been increasing, and is now and then referred to the knee. During the last two weeks the joint has become almost immovable. He has been able to walk some, although it gives him a good deal of pain. He limped into the hospital.

Examination.—When the patient lies flat on his back with both legs extended, the anterior superior iliac spines appear to be on a level. There is very slight apparent shortening of the

left leg. This, however, is due to real shortening between the trochanter and external malleolus. There is no shortening between the iliac spine and great trochanter. The hip is fixed at about 25°. There is no apparent abduction or adduction. Any attempt at motion at the hip joint gives pain, and with each motion the pelvis moves with the limb. There is no swelling about the hip joint except on the anterior surface of the thigh. This swelling is situated below the outer two-thirds of Poupart's ligament, to the outer side of the vessels and extends downwards a distance of about 4 cm. It is most prominent 2 cm. within the line of the tensor vaginæ femoris and 2 cm. below the iliac spine. The swelling is not very painful and on palpation seems to fluctuate. When the patient is quiet in bed and does not attempt to move the limb he suffers no pain. The leg is only painful when he attempts to walk or when some one attempts to bend it at the hip joint. The examination of the lungs was negative. The general health of the patient appears to be excellent. The patient remained under observation from November 30th to December 8th. On December 2nd, following an injection of 2 milligrams of tuberculin, the temperature rose to 100.5°. On December 4th, following 4 milligrams of tuberculin, the temperature rose to 100°. With these two exceptions, a two-hour chart shows a registration of rectal temperature between 98.5° and 99.5°. Following the injections of tuberculin the patient complained of no discomfort whatever. The only fact to be noted was that shown in the slight fever. The leucocyte count before operation was 4,000.

The arthritis was considered to be, without much doubt, tubercular, and the swelling on the anterior surface of the thigh to be due to distention of the capsule of the hip joint which had not yet ruptured.

Operation.—December 8, 1898. Anæsthetic, ether. When the patient was fully narcotized, it was demonstrated that with the exception of flexion there was but little restriction of motion in the hip joint. An incision was made in the anterior surface of the thigh, beginning at the anterior iliac spine, and the capsule of the hip joint was exposed by separating the tensor vaginæ femoris on the outer side from the rectus muscle on the medial side. As soon as the muscles were separated a tense swelling was found, which upon its surface was smooth

* Read before the Johns Hopkins Hospital Medical Society, May 8th, 1899.

and white in color. Upon its outer surface there was no exudate, nor was it adherent by connective tissue to any of the surrounding structures. When incised, it was found to be from 3 to 4 mm. in thickness, of firm white tissue, and proved to be the distended capsule of the joint. The cavity contained a large amount of viscid serous fluid containing numerous flakes of lymph and some necrotic material. The inner surface of the capsule of the joint presented the ordinary picture of tubercular synovitis. Here and there one saw oedematous hemorrhagic granulation tissue, in which were areas of yellow necrotic tissue, which could be easily scraped from its fibrous base. Between these areas of granulation tissue were smooth areas paler in color. On retracting the muscles more widely and enlarging the opening in the capsule, the head and neck of the femur were easily exposed. The examining finger at once found a small cavity on the inferior and slightly anterior surface of the neck, near its junction with the head of the bone, which about admitted the index finger (Fig. 1 *a*). One could also see the cavity, and in its



CASE I. FIG. 1.—*a*. Focus of tubercular osteomyelitis. *b*. Area of bone removed.

center was a small area of yellow necrotic tissue. The bone lining the cavity was slightly hemorrhagic, but when cut with the chisel was found not to be very soft. About 3 to 4 mm. of bone about the cavity were removed with the chisel (Fig. 1 *b*.) Beyond this, the cancellous bone appeared to be normal. The head of the femur was easily seen. The cartilage was not eroded. The cartilage lining the cotyloid cavity could be seen only at the rim about the head. It also appeared to be normal. The trochanter and shaft of the femur were exposed. The periosteum was not thickened. The entire surface of the capsule of

the joint was curetted. The bone cavity in the neck, and the surface of the synovial membrane after curetting were swabbed with pure carbolic. The wound was then thoroughly irrigated with 1 to 1000 bichloride, followed with salt solution. After mixing iodoform powder with the blood clot, the wound was closed, leaving a small drain extending into the capsule but not into the cavity in the bone. The entire limb and pelvis were fixed in a fully extended and slightly abducted position in plaster.

Notes after Operation.—The patient was perfectly comfortable and at no time during the convalescence experienced pain in the wound. The night after operation the temperature rose to 103.2°, falling to normal in the morning. On the second evening it rose to 104°; on the third to 103°; and on the fourth to 102°, falling to normal each morning. With this rise of temperature there was very little change in the pulse. The leucocyte count varied from 2700 to 4000. Nothing was found to explain the fever. Culture and cover-slips from the serum in the wound were sterile. From December 12th to January 28th the temperature chart records no fever. The drain was removed on the sixteenth day. For four weeks the sinus communicating with the joint was irrigated daily with 1 to 1000 bichloride and injected with an emulsion of iodoformized oil. The wound at no time showed any evidence of infection and was completely closed at the end of five weeks. The patient was kept in bed in extension for six weeks, and then allowed to get up in plaster.

Note, August 14, 1899. The patient returns to the hospital walking without crutches or cane. It is eight months since the operation and six months since the plaster cast was removed. For five months the patient has been able to return to his work as a butcher. He has had no further pain. The wound is healed solidly. Careful measurements show no difference in the length of the bone or between the anterior iliac spine and trochanter, except the one noted before operation of 1 cm. shortening between the trochanter and external malleolus. Motions in the left hip joint are possible in every direction, and are but very little restricted in each (see Figs. 2, 3, 4). Forced motions are painless. Previous to operation the left leg was flexed to 25 degrees; it now can be fully extended without change in the pelvis.

Examination.—January 10, 1900. The patient's condition is the same as that noted in August. The result so far appears to be a perfect one, not only with every evidence of an eradication of the disease, but with complete function of the joint. (See Case IX for operation in the right hip.)

CASE II.—*Tuberculosis of right hip, of seven years' duration. Operation: Firm fibrous ankylosis; no evidence of bone or joint tuberculosis; incapsulated extra-articular tubercular abscess. Result, Jan. 1900, 9 months, excellent.*

Surg. No. 3540. There is at present (May, 1899) in the wards, a young girl who was admitted to the hospital November, 1, 1894. At that time she was suffering with tuberculosis of the right hip, the onset of which had been two years previous, when she was eleven years of age; that is, seven years ago.

Examination.—November 5, 1894, under ether. No apparent shortening. The right (affected) limb is flexed to 45 degrees,

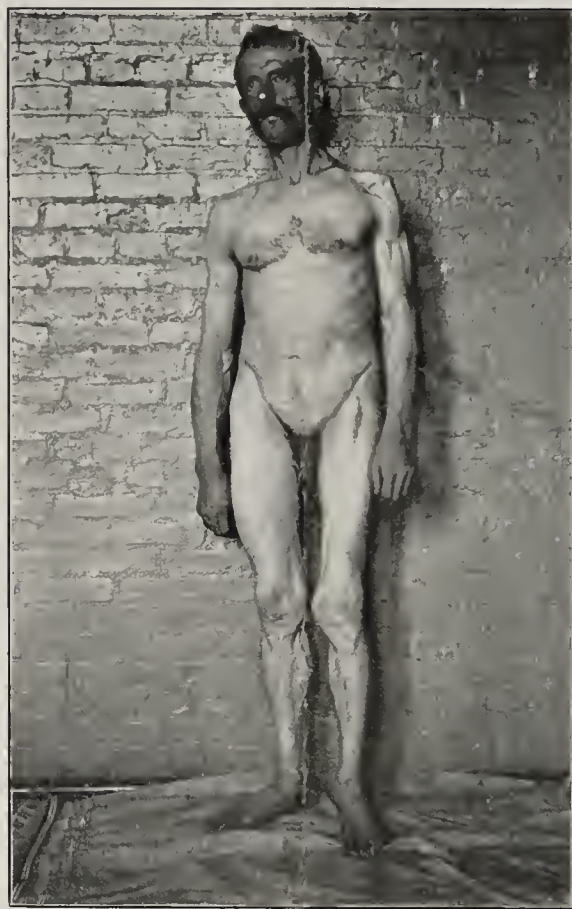


FIG. 2.—Result in Case I, eight months after operation.



FIG. 3.—Limit of abduction, Case I.

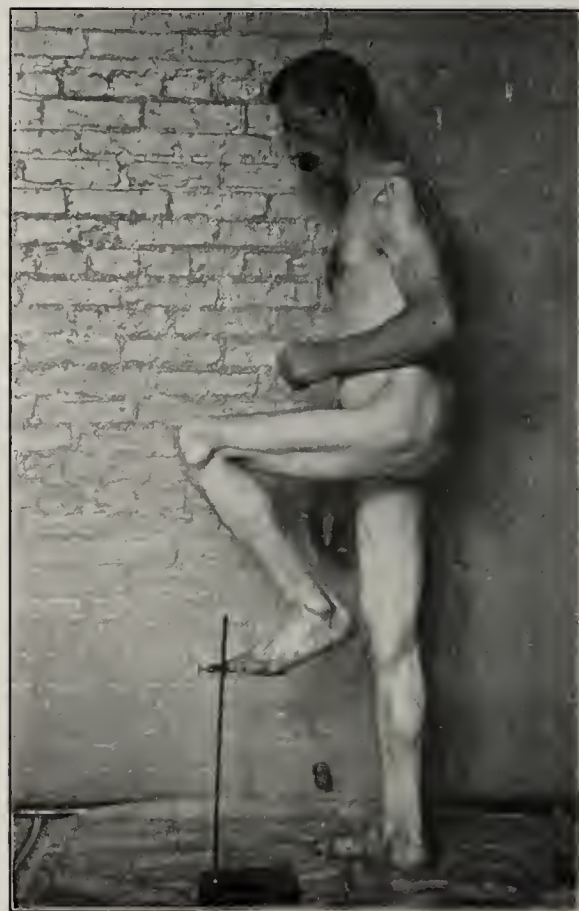


FIG. 4.—Limit of flexion, Case I.

slightly abducted and slightly rotated out. Apparently no real shortening between anterior iliac spine and trochanter or trochanter and external malleolus. The measured shortening between anterior iliac spine and internal malleolus 1 cm. (due to abduction).

Examination.—April 25, 1895, after seven months. The flexion is less 20 degrees. Apparent shortening 1 cm., due to tilting up of the pelvis. Measured shortening between iliac spine and external malleolus 2.5 cm. Real shortening between iliac spine and trochanter perhaps 1 cm. Patient is very fat, and these measurements are difficult to make. The leg is still slightly abducted. Rotation out less.

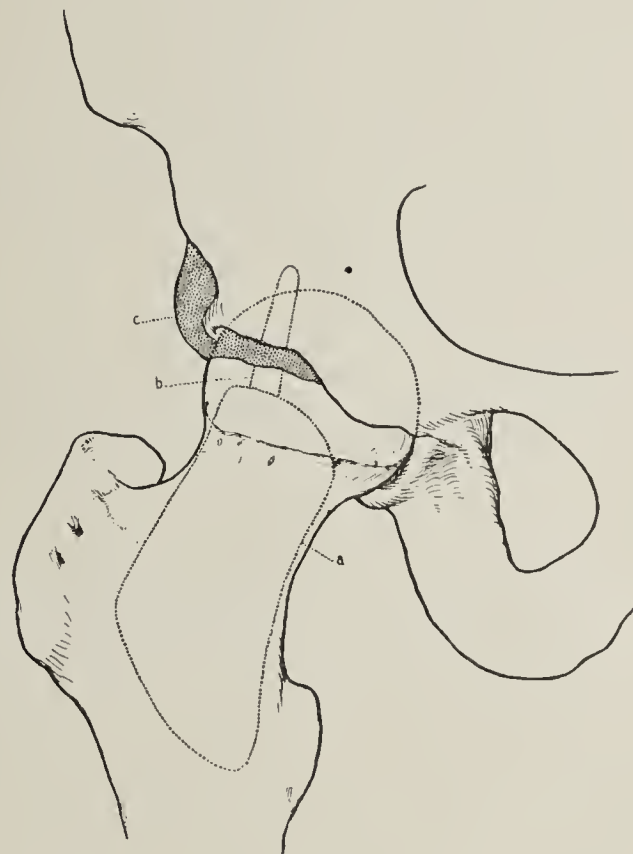
Examination.—December 8, 1896, after two years. Apparent shortening 3 cm. Real shortening between anterior iliac spine and trochanter 1 to 1.5 cm.; between trochanter and external malleolus 2.5 cm. (about equally distributed between thigh and leg). These measurements demonstrate that within the last two years, under the best orthopedic treatment, a centimeter of real shortening has taken place, and there has been a lack of growth in the shaft of the femur of 2.5 cm.

Examination.—April, 1898. Very little if any change.

From November, 1894, up to the present time, a period of almost five years, she has been under treatment. After her first admission to the hospital she remained in the wards for two years. The treatment consisted of iodoform injections, and later of fixation in plaster. During this time her general health has remained about the same. There has been little or no loss of flesh, no fever, and no evidence of tuberculosis elsewhere. On December 6, 1896, she was given tuberculin, which was followed by no evidence of reaction. Four weeks later an abscess formed below the great trochanter. It was opened, and healed rapidly. In October, 1897, there was slight reaction to tuberculin. About four weeks ago she returned to the hospital for inspection. She was still using crutches, and suffered a good deal of pain in the hip, not only during the day when she was sitting in a chair or walking on her crutches, but also at night. This pain was generally relieved by extension.

Operation.—April 20, 1899. Ether. Under the anæsthetic it was found that the hip joint was almost completely fixed in a flexed and very slightly abducted position, with no rotation. An incision similar to that employed in the first case was made. On dividing the fascia lata about 5 cm. below the anterior iliac spine, a small cavity (2 cm. in diameter) was opened. In the center of the cavity was a mass of yellow necrotic material and a little clear serous fluid. The wall of the cavity was of smooth white fibrous tissue. No granulation tissue could be found. This cavity corresponded in position to the abscess which formed and healed a year and a half ago. It was completely excised and no communication between it and the bone or joint could be demonstrated. (A very small healed sinus, however, might have been overlooked). On exposing the joint, the head and neck and trochanter of the femur were covered with dense connective tissue. This was excised, exposing the periosteum over the trochanter and upper part of the shaft. The periosteum was slightly thickened, and on stripping it back the bone was a little rough. The outer layers of the bone of the shaft and trochanter were very thin, also that of the neck. The anterior surface of the neck, troch-

anter and shaft was removed with a chisel (Fig. 5 *a*). The cancellous bone was very soft and hemorrhagic; the marrow was also fatty and very hemorrhagic. The head of the bone and the acetabular cavity were covered with scar tissue, in which no granulation tissue could be found. Over a small portion of the head of the bone which was exposed there was normal cartilage. No disease of the pelvic bones about the acetabular cavity could be demonstrated. About the acetabular cavity there was a narrow ridge of new bone (Fig. 5 *c*). The wound was thoroughly irrigated, and the small bone cavity made during the exploration was allowed to fill with blood clot mixed with iodoform, and the wound closed without drainage.



CASE II. FIG. 5.—*a*. Area of outer table removed to expose neck, epiphysial line and head. *b*. Gouge groove to explore acetabulum through head. *c*. New bone about rim of acetabulum.

At the operation, although the junction of the neck and the shaft was exposed, it was difficult to tell whether the angle between the neck and the shaft were more or less than normal. The neck, however appeared to be shorter than normal. Following the operation, the patient had no discomfort and the wound healed perfectly. She was discharged September 15, 1899, wearing a splint and using crutches. This supporting apparatus was used because I feared that following the removal of the bone, the neck of the femur might possibly have been weakened, and that to allow the patient to walk without some support might be followed by bending of the neck with its resultant deformity. While in the hospital, especially after the patient was up and about on crutches, the pain complained of before operation was not present.

Examination.—January 19, 1900. The patient has no pain. She walks much better but still uses the crutches and wears

the splint. No change in measurement. Advised to discontinue crutches and later the splint.

I have reported these cases to the Society to illustrate the happy result, in the first case, after an early operation. Here, seven weeks after the beginning of the disease, we found a greatly distended capsule filled with necrotic material and lined by tubercular granulation tissue and a tubercular focus in the neck of the femur. Following the partial removal of the disease of the soft parts and the apparent complete removal of the disease of the bone, we have every evidence of the complete cure of the disease, and three months after operation the patient is able to resume his occupation as a butcher, and the functional use of the joint is almost perfect.

In the second case, after seven years of conscientious orthopedic treatment, the patient is practically in the same condition. The exploratory operation, however, demonstrated that the disease was to all appearances cured. In this latter case an earlier exploratory operation, if it had demonstrated the same condition, would have relieved the patient of a number of years of enforced rest, or, if the disease had been present, would have allowed its earlier eradication.

ADDITIONAL CASES.

Note, January, 1900.—Since the above report was made, twelve cases of tuberculosis of the hip have been subjected to operation. Nine are here reported—three cases of very recent date not being included in this report. In all, the immediate results have been very encouraging.

CASE III.—*Tuberculosis of left hip, of 15 months' duration. No relief of symptoms after two and a half months' treatment with extension in bed. Operation: Distention of capsule; erosion of head and neck; no bone foci found; immediate relief of symptoms. Result January 1, 1899, six months, excellent.*

G. L. H. Surgical No. 8874. Male, æt. 10. Was admitted April 19, 1899, complaining of pain in the left leg. His father died of tuberculosis of lungs, and one brother had been operated upon in this hospital for *genu varum*. About fifteen months ago this patient complained of pain in the left hip. The pain was intermittent, but had not prevented him from going to school or playing about; now and then he would limp; for different periods he would be free from pain and limping; no history of trauma. About six weeks ago, after a well interval, he complained of sudden pain in the left hip and began to limp. The pain in a day increased so rapidly that he went to bed, being unable to walk, and that night, for the first time, cried out from pain. Being more comfortable the next day he was taken to a hospital where he remained a few days, and left with a brace. Yesterday, twenty-four hours before admission, he fell on the brace and had passed a very uncomfortable night.

Examination.—The left hip was so tender that any attempt at motion produced much pain, and an examination was made with difficulty. There was flexion (40°), abduction (45°), but no eversion. From April 20th to May 12th (22 days) the patient was placed in extension, and was more comfortable. Measurements made on the last day showed apparent shortening of .5 cm., due to slight adduction, but no real shortening. The hip was still very tender and fixed. April 29, reaction to tuberculin. From May 28th to July 2nd, although the patient was in extension, night cries increased and he was uncomfortable. From July 2nd it was noticed that there was a fullness in Scarpa's triangle. The hip was still very painful and fixed in a position of flexion and adduction. For this reason an operation was decided upon.

July 3, 1899. Operation (Dr. Cushing): Ether; anterior incision. The joint capsule was distended and thickened; no evidence of rupture. On incising the capsule, about an ounce of seropurulent fluid escaped. A part of the cartilage over the head was roughened and slightly elevated from the bone. The joint cavity was full of tubercular granulation tissue. In places one could see that the cartilage of the acetabulum was eroded and lifted from its base. A portion of the anterior surface of the head and neck was chiseled away, showing the epiphysial line. No focus of disease in the bone was found. The area of most marked erosion of the cartilage, and the erosion of the bone at the edge of the epiphysis, as shown in (Fig. 6, *a. a. a.*) were chiseled away. After disinfection



CASE III. FIG. 6.—*a. a. a.* Areas of superficial erosion. *b.* Areas removed.

of the joint and bone cavity, dry iodoform was dusted in the wound, which was closed without drainage. The operation lasted one hour and five minutes.

For a few days previous to operation the pulse ranged between 90 and 100, and for three days after operation it ranged between 120 and 150; the temperature rose to 102° . By the seventh day pulse and temperature had reached normal. The patient was comfortable.

On August 2nd (thirty days after), a small sinus opened in the wound, discharging a clear, serous fluid, which completely healed on August 29th. Measurements made on August 30th showed a lengthening of 1 cm. and no real shortening. The flexion had disappeared, and there was a slight tendency to outward rotation. Motion in the joint was much less restricted. On August 31st, two months after the operation, the patient was fitted with a brace. On September 6th he left the hospital wearing a brace.

In this case the usual orthopedic treatment of extension and rest in bed had been given a fair trial, but did not relieve the symptoms. At the operation, tension was relieved by incision and drainage of the distended capsule, after which the patient was much more comfortable. The incision of the capsule also allowed

correction of the flexion, and a short time after the operation all movements of the hip joint were freer and without pain.

CASE IV.—*Tuberculosis of left hip, of one year's duration. Operation: Distended capsule, with purulent material; synovial membrane converted into granulation tissue; slight erosion of head and neck and acetabulum; wound closed; healing per primam. Result, January, 1899, six months, excellent.*

Surgical No. 9234. W. C., colored boy, æt. 2 years. Admitted July 26, 1899. One year ago the child complained of pain and tenderness in the left hip, and in a few days began to limp. The parents noticed that the leg became shorter; the pain was worse at night, and there were night cries. The child continued to walk a little.

Examination.—The general condition was good; no evidence of rickets. The left leg was flexed to 70 degrees at the hip and 45 degrees at the knee, and adducted. Motions at the hip are restricted in all directions, but not at the knee. It was difficult to make accurate measurements, but there appeared to be no real shortening.

August 2nd (six days after admission). Operation (Dr. Mitchell): Ether; anterior incision. The capsule of the joint was thickened and oedematous. On incising the capsule, an ounce of thin, brownish, purulent and necrotic material escaped. The synovial tissue seemed to be converted into granulation tissue. There was noticed a slight erosion on the anterior and superior surfaces of the neck at its junction with the head; round ligaments, intact; the rim of the acetabular cavity was covered with grayish granulation tissue; both of these areas, as well as the capsule of the joint, were curetted. The wound was irrigated with salt solution, dusted with dry iodoform powder, and closed without drainage. The full time of the operation was fifty-five minutes.

Pulse previous to the operation was 120; during the operation, 140. The chart registers an average pulse of 120 previous to operation and one rise of temperature to 103°, which, however, followed tuberculin given on the 27th of July. Following the operation the highest temperature was 101.5°, the evening of the first day, and the pulse rose to 180, but fell that evening to 130; up to November 27th, when patient was discharged, the average pulse was from 110 to 120. With the exception of a slight rise of temperature to 102° on October 2nd, there was no fever after August 4th, 48 hours after operation. The patient left the hospital on November 27th in plaster. The wound healed per primam.

CASE V.—*Tuberculosis of left hip. Subgluteal extra-articular abscess. Operation: Incision of abscess and arthrotomy; tubercular synovitis; erosion of head and neck; posterior perforation of capsule. Result, January 1, 1899, two months, improved.*

J. W. G., colored boy, æt. 2 years. Admitted November 9, 1899. The parents not being with the child it was impossible to get a history.

Examination.—The child is placed flat on his back. The left anterior iliac spine (the affected side) is a little lower than the right. There is a marked lumbar lordosis unless the left hip is flexed to a position of 90 degrees; motion at the hip joint in this position is possible in all directions, but only to a few degrees. The knee is flexed to an angle of 90 degrees. Extension is only possible to a few degrees; no rotation of thigh. If the right leg is placed in a similar flexed position at the knee and hip, there is an apparent shortening of about 1 cm., but no real shortening of the left leg. Between the anterior iliac spine and trochanter on the outer surface of the left thigh and beneath the gluteal muscles there is a fluctuating swelling.

Operation.—November 11, 1899. Ether. Under complete narcosis the leg can be very slightly flexed and extended. This restriction almost completely disappeared after the abscess was incised. The abscess was situated beneath the gluteal muscles and fascia

lata and contained thick, gelatinous, purulent material, with shreds of necrotic tissue, and was found to communicate with the hip joint through a small opening in the posterior wall of the capsule. The joint capsule, which was not distended, was opened through the usual anterior incision. The synovial membrane was covered with tubercular granulation tissue. On account of the youth of the child, a large incision was not made, so that the head, neck and acetabular cavity were not seen, but with the index finger erosions were felt on the anterior surface of the head and neck, which were curetted. The abscess and the capsule of the joint were also curetted, swabbed with pure carbolic, irrigated with salt solution and filled with emulsion of iodoform and oil. The operation took fifty-five minutes. Very little ether was given. The condition of the patient at the end of operation was excellent.

January 15, 1900. The child is still in extension, which has reduced the flexion of both knee and hip from 90 to 35 degrees. There are no night cries. The patient appears to be perfectly comfortable. The wound is now a superficial granulating area.

CASE VI. *Tuberculosis of left hip, of seven months' duration. No relief of symptoms after one month's treatment with extension. Operation: Tense distended capsule; no bone focus of disease; slight erosion of the head, with loosening of articular cartilage; round ligaments separated; wound closed; healing per primam. In six weeks the wound reopened. Second operation. Result, January, 1899, after two months, excellent. Wound closed.*

Surgical No. 9117. G. B., æt. 4½ years; admitted June 26, 1899. One and one-half years ago the boy fell on the ice and bruised his left hip. An area of ecchymosis over the hip remained some days. Following the injury, however, there was no special pain complained of and no limp. Eleven months later (that is, 7 months ago), the parents noticed that the child began to limp, and complain of pain, first in the calf of the leg, later in the ankle, then in the knee. About two months later the parents noticed that the affected leg was shorter and the boy walked on his toes. In about a month he began to have night cries. For the past two weeks the boy has been unable to walk on account of pain.

Examination—The left leg is flexed at the knee and thigh, with marked adduction; no rotation; very little motion at the hip joint. The patient was placed in extension from June 26th to July 24th. He cried a good deal at night, when asleep or awake. All attempts to overcome the flexion by extension were unsuccessful. Manipulation of the hip joint continued to be painful; for this reason operation was decided upon.

Operation.—July 24, 1899 (Dr. Cushing): Ether; anterior incision. After separating the muscles a very tense distended capsule was exposed; it was incised, and about an ounce of flocculent, yellow, serous fluid was evacuated. The joint, head and neck of the bone were thoroughly exposed. The round ligament seemed to be destroyed. When the thigh was flexed, one got a good view of the acetabular cavity. The lining cartilage seemed smooth. The cartilage over the head of the bone appeared to be loose. The head epiphysial line was exposed by chiseling. No focus of disease was seen. The wound was irrigated with salt solution, dusted with dry iodoform powder, and closed without drainage.

Dr. Cushing noticed that under an anæsthetic the leg could not be fully extended. As soon as the capsule was incised and the tension was relieved, full extension was possible. Time of operation about fifty-five minutes; pulse before operation, 120; during operation about 140. As in the previous cases in children there was a slight tachycardia after the operation for five days, and some fever for three days. The wound healed per primam.

It was noticed on August 5th, 11 days after operation, that the leg was but slightly flexed, very little adducted, but there was slight outward rotation. On the 14th of August there was no flexion. At this time he was sent into the country in a brace.

On September 6, 1899, about a month later, he was readmitted

to the hospital, not in as good condition as when he left. He had night cries and some pain. Twenty days after admission a sinus formed in the wound which discharged tubercular pus.

From September 28th to November 4th he was placed in extension. November 3d, measurements: Apparent shortening of 1 cm., and real shortening from trochanter to anterior iliac spine of about 1 cm. No abduction or adduction or flexion, but marked outward rotation. The hip is pretty firmly fixed in this position except that it can be slightly rotated in.

Operation, November 4, 1899 (Bloodgood): Ether. It was found that the sinus of the previous operation passed through the rectus muscle into the joint. At this second operation the joint was exposed by an incision which separated the tensor vaginae femoris and gluteus medius on the outer side and the sartorius and rectus on the medial side. The sinus and cavity corresponding to the capsule of the joint were lined with tubercular granulation tissue. It was found that the head and neck of the bone were intact. A few pieces of partly separated cartilage were removed from the head of the femur. The outer surface of the neck was rough, soft and hemorrhagic. On extending the femur and pushing it upwards, the head of the bone moved a little in each direction. Under ether there was very little restriction of motion at the hip joint. The soft parts and bone surface were curetted, the exposed surfaces were swabbed with pure carbolic, the wound irrigated with salt solution, dusted with dry iodoform powder, and closed with a piece of protective drain into the joint cavity. No loss of blood; no shock. Time of operation was about sixty minutes. Average pulse about 140.

Following the operation there was a slight tachycardia for a few days, but no rise of temperature. The operation in this case was a secondary one and of less extent than others. The patient was put up in plaster and later in extension, and was much more comfortable than previous to operation. The wound was irrigated, and at frequent intervals swabbed with pure carbolic and filled with emulsion of oil.

Note.—December 9, 1899, 35 days after operation. Measurements between iliac spine and trochanter and iliac spine and malleoli are about equal. Position of leg after removal of extension is as follows: The left (affected) anterior iliac spine is elevated 1 cm., the left leg is rotated out perhaps a little more than the right (this outward rotation is much less than previous to operation). The apparent shortening (1 cm.) corresponds to the elevation of the iliac spine. There is no flexion. The motions of the hip joint are about 10 degrees in flexion and extension; adduction to a few degrees; no restriction of outward rotation; a marked restriction of inward rotation and abduction. Although the hip is pretty well fixed, the position could not be a better one. Attempts at motion are not painful. The wound has healed.

December 15, 1899. The patient is in the hospital, and is walking about on crutches, in a brace.

CASE VII. *Tuberculosis of left hip, of one year's duration. Subgluteal, extra-articular abscess and abscess beneath the adductor muscles. These abscesses developed during orthopedic treatment. Operation: Incision of subgluteal abscess; anterior arthrotomy of joint; anterior and posterior perforation of joint; abscess beneath adductors drained through joint; tubercular focus in neck. Result, January, 1899, two months, improved.*

Surgical No. 8201. Boy, æt. 8 years. Admitted October 6, 1898, one year ago. The arthritis of the left hip had been present one year, following traumatism. The limb was in a position of flexion (28 degrees) and adduction (21 degrees), with slight internal rotation. Apparent shortening, 4 cm.; real shortening (anterior iliac spine to trochanter), 1 cm. Muscle spasm was marked. There was no evidence of abscess. The patient was placed in bed in an extension apparatus, which at once relieved the pain. He was discharged February 28, 1899 (five months), wearing a splint, and

appeared to be in excellent health. This patient was readmitted October 1, 1899, not because he was suffering any pain or discomfort, but in answer to a letter inquiring as to his present condition. He was still wearing the splint and walking with crutches. When the splint was removed and the patient placed in bed, and the anterior iliac spines fixed to the same horizontal plane, the left affected leg was so adducted that it crossed its fellow on a level with the patella. There was a large abscess behind the great trochanter in the gluteal region, and a slight fullness beneath the adductor muscles. The patient was observed in the hospital from October 1st to October 28th. There was no fever. He suffered no pain except when the apparatus was removed or when forced motions were attempted at the hip.

Operation.—October 29, 1899. Ether. The gluteal abscess was incised. It was situated between the gluteus minimus and medius and extended down to the middle third of the leg beneath the fascia lata. Passing the index finger, one could feel the capsule of the joint on its posterior surface. In this position a probe found communication with the joint cavity.

The usual exploratory incision on the anterior surface of the thigh was then made. The capsule of the joint when exposed was slightly distended, but on its outer surface there was no exudate and no adhesions. When incised, it was slightly thickened, and the joint cavity contained a moderate amount of seropurulent material filled with cheesy necrotic masses. The head and neck of the bone were easily felt and seen, and on the anterior and slightly inferior surface of the neck, near its junction with the head, a small tubercular bone focus was found. (Similar to Case I, Fig. 1.) This was removed with a chisel. The head of the bone seemed firmly in place in the joint cavity, and there was very little restriction of motion. The rim of cartilage which could be seen was not eroded. By pressure over the thigh in the adductor region, a great amount of tubercular pus was expressed into the joint cavity, and the finger and probe demonstrated a second opening in the capsule of the joint leading to a large abscess cavity on the lateral surface of the thigh, beneath the adductor muscles. This opening was enlarged and the cavity curetted out. The patient had a comfortable convalescence. January, 1900. Extension has corrected to some extent the adduction and flexion. The patient walks well in his brace. The wounds are almost healed. The marked adduction will need further operative treatment.

CASE VIII.—*Tuberculosis of right hip; orthopedic treatment for 12 months, during which time an iliac abscess, from perforation of the acetabulum, developed. Operation: Incision of abscess and arthrotomy of joint; tubercular synovitis; slight erosions of head and neck, with partial separation of the articular cartilage of head and acetabulum. Result, January 1899, two months, excellent.*

Surgical No. 8086. R. H., æt. 4. First admitted September 7th, 1898, with the following history: About five months ago it was noticed that the child limped; at the same time the parents noticed that the right ankle was swollen. Six weeks later the child awakened at night, crying from pain in the hip; next day was unable to walk; this pain and inability to walk disappeared in a few days, the night cries and pain at night continuing. About eight weeks ago a slight trauma was received by the right knee; The knee became swollen and was put up in plaster by a physician. Night cries continued. The hip became more stiff.

Examination. The child walked into the hospital. The limb is flexed; slightly adducted; no rotation of foot; apparent shortening of about 1 cm.; no real shortening between anterior iliac spine and trochanter; no fullness in Scarpa's triangle; adduction is impossible, and there is about 10 degrees of abduction. Patient was placed in extension September 25th. 18 days later, he was discharged from the hospital, wearing a brace and using crutches, with a high shoe on the left foot. March 29, 1899, 7½ months, patient was readmitted.

Examination. Perfectly comfortable. Night cries have ceased. Examination reveals no muscle spasm. There is no flexion, abduction or adduction. Apparent shortening is $\frac{1}{4}$ cm. There is very little motion at the hip. No real shortening between trochanter and anterior iliac spine. May 6th, 37 days, discharged, wearing a splint and using high crutches and high shoe. On October 27, 1899, five months latter, he was readmitted, not because of any pain or discomfort, but on account of swelling which had been noted for two weeks over the outer third of Poupart's ligament. **Measurements:** No apparent shortening; no real shortening. Leg is in a straight position, slightly rotated out. Flexion is possible to 30 degrees; abduction to 10 degrees, but adduction is impossible. There is only slight muscle spasm, associated with attempts at motion. On account of the abscess an operation was decided upon.

Operation.—November 4, 1899. Ether. Usual anterior incision, which also opened into the abscess. The abscess cavity was between the skin and fascia of the muscle. From it a sinus led below Poupart's ligament, passing between the sartorius and tensor vaginæ femoris, then into the iliac fossa, anterior to the sheath of the iliac muscle. After curetting this abscess cavity the joint capsule was exposed by separating the rectus from the tensor vaginæ femoris. No infiltration of the tissues outside the capsule. By pressure over the capsule a purulent material was expressed from the sinus, but on opening the capsule of the joint a direct communication could not be found. The cartilage of the head of the femur was soft and separated easily; it was removed by catching it with a clamp. The base consisted of soft hemorrhagic bone, the gross picture of tuberculosis. The anterior surface of the head and neck was chiseled. There was no evidence of disease in the neck, which seemed to be confined to the head of the bone, especially beneath the cartilage. The round ligaments had been torn and that portion of the acetabular cavity which was exposed showed evidence of disease. The cartilage was soft, and some could be pulled away, leaving a base of soft hemorrhagic bone. No attempt was made to find out the direct communication between the joint and the iliac abscess, as it would have required too much destruction of bone. The abscess cavity was traced into the pelvis between the iliac and the psoas muscle. The wounds were swabbed out with pure carbolic, irrigated with salt solution and dusted with dry iodoform. A protective drain was left into the abscess cavity and into the joint. Time of operation was about one hour and thirty-five minutes. Patient was in excellent condition.

Following the operation there was the usual tachycardia pulse of 130 to 160 for about ten hours; no rise in temperature; no pain or discomfort.

Examination.—December 1, 1899, twenty-seven days since operation. There is no apparent shortening. The anterior iliac spines are about even. Both legs are straight; no outward rotation; no real shortening; position of the leg is perfect. Flexion, extension, abduction and adduction and outward rotation are possible only to a few degrees. Inward rotation from a position of outward rotation is possible to a greater extent than outward rotation. Attempts at motion give no pain.

Wound healed except a small granulating area and a sinus communicating with the abscess cavity. Patient is ordered brace, high shoe and crutches.

January, 1900. No change.

CASE IX. Tuberculosis of right hip. Slight symptoms four months; very acute symptoms three days. Operation at once. Capsule distended, very tense; synovial membrane hyperemic; on chiseling outer table of neck, a definite bone focus found in the neck near epiphysal line. January 1, 1900, six weeks, excellent result.

Surgical No. 9699. N. K., æt. 40. Admitted November 22, 1899. In July (four months ago) patient began to have pain in the right hip, and he stopped work and rested for about two weeks. Was comfortable when he kept quiet. Returning to work, he was free

from pain for a couple of weeks, but since that time he has found that he has to rest quite frequently during the day when these attacks of pain come on. He is a butcher by trade and has to stand a good deal. Three days before admission, while at work, he was seized suddenly with severe pain, so intense that he went home to bed, and sent for a physician who gave him morphia, but this did not relieve the pain. He was brought to the hospital on a stretcher in the ambulance.

The right leg was fixed in a position of flexion of about 45 degrees. Any attempt at motion was intensely painful. Extension was at once applied in this flexed position, which in a few hours relieved the patient of the pain. Next morning he was more comfortable. On examination there was a distinct fullness in Scarpa's triangle. The history and the present condition were similar to the attack in the left hip joint (Case I). There is no apparent or real shortening. The result in the left hip is a perfect one. The patient was in extension with complete relief of symptoms from November 22nd to November 27th, but any attempt at motion gave him pain. Chart records a temperature between 99° and 101°; pulse of 70 to 80.



CASE IX. FIG. 7.—a. Tubercular osteomyelitic focus. b. Area of outer table chiseled to expose and remove a and b. c. Area of softened cancellous bone.

Operation.—November 27, 1899. Cocaine and chloroform. The usual anterior incision was made without difficulty under cocaine, but it was found that the retraction of the muscles necessary to expose the hip joint was so painful that chloroform was given. As soon as the patient was under the anæsthetic it was still found that complete extension was impossible. The capsule of the joint was distended. On incision a fluid spurted out, demonstrating the great tension. It was a seropurulent fluid filled with coagulated lymph. On examining the capsule carefully, it was found that the synovial membrane was intensely injected and hyperemic. There was no evidence of granulation tissue. The head of the bone was easily seen in the acetabular cavity, and the cartilage, both on the head and acetabular rim, seemed normal and was not sepa-

rated. No disease could be seen at the head or neck or trochanter of the femur. The bone of the anterior surface of the neck, between head and trochanter, was chiseled (Fig. 7*b*), and in the epiphysial line, between the head and neck, on the anterior and inferior surface, a small focus (about 5 mm. in diameter) of definitely tuberculous bone was found (Fig. 7*a*). Surrounding this and extending into the head and neck, the bone was soft and hemorrhagic (Fig. 7*c*.) The tuberculous area and this softer cancellous bone were removed with the curette. The appearance of the bone lining the cavity was normal except perhaps slightly hemorrhagic but firm. The bone cavity and joint capsule were swabbed out with pure carbolic, irrigated with salt solution, and the bone cavity allowed to fill with blood mixed with iodoform. The wound was closed with a small drain extending into the capsule but not into the bone cavity. Operation required two hours and ten minutes. There was no shock, and the condition of the patient at the end of the operation was excellent.

Examination.—December 16, 1899. Wound is healed with the exception of a small sinus which was filled with iodoform and organized blood clot. Patient has had absolutely no discomfort since operation, and for about seven days has moved his right hip in every direction, and we find on examination to-day that one is able to flex, abduct and adduct, rotate in and rotate the hip outwards to quite a marked degree, but not completely. These motions are without pain. January 12, 1900. The patient is up on crutches; the wound is healed except a small superficial area. Passive and active motions with hip are but slightly restricted and give no pain.

For some years before this report, which I made to the Society in May, 1899, I had given a good deal of consideration to the subject of tuberculosis of the joints, and especially of the hip, and had been forced to the conclusion that there was much room for improvement upon the usual orthopedic treatment. I had in mind early exploratory operations in which the surgeon might be fortunate to find the focus of the disease in the bone at a period when its complete excision; or, if the tubercular osteomyelitis were more extensive, a partial excision might be done without interfering with the continuity of the bone or function of the joint. From early experiences, especially in the knee, arthrotomy with irrigations with antiseptics and injections of large quantities of iodoform seems to have been the best procedure for treatment of the tuberculosis of the synovial membrane.

The majority of surgeons now follow the more conservative and orthopedic treatment. In the past many, and at present, without doubt, some, surgeons resort to operation, even early in the disease, but as a rule such operations have been accompanied with excision of at least the head of the femur and frequently more, of the neck and trochanter.

My first object in the early operation for tuberculosis of the hip was to avoid a complete removal of the head or of an amount of bone sufficient to interfere with the continuity of the upper end of the femur, or function of the joint, to excise the diseased bone only in small areas by a gouge and curette, trusting to antiseptic irrigation, and especially to the healing process, to check the further extension of the tubercular processes, and to encourage healing of the tissues already diseased, both of bone and soft parts. Every surgeon must have observed, especially in excisions of the knee, that tuberculous bone has frequently been left behind, but that the disease has been cured. Change of circulation, due to the operative interference, and the scar tissue of the healing process, both seem to exert a curative influence on the tubercular tissues.

The more frequently one operates, and the earlier in the disease, the more frequently he may be fortunate in finding single focus, of tubercular osteomyelitis which can be completely excised without injury to the continuity of the bone or function of the joint as in Cases I and IX. As our experience grows, I trust we will find that early operations check the disease with more certainty and in a greater number of cases than the usual orthopedic treatment. I trust also we will find that it shortens the period of treatment.

In five of these cases the joint capsule was greatly distended. It would seem beyond question that arthrotomy and irrigation in such cases are the only reasonable treatment. The symptoms due to tension are relieved, and both the infiltrated and uninfiltrated tissues, relieved of this pressure, are better able to take care of the tubercular process. In addition, the arthrotomy allows a thorough local disinfection of the surfaces of the capsule and bone, and with the aid of a small gouge one is able to explore the trochanter and neck and head of the femur without endangering the continuity of the bone. In this early exploration, any focus of bone can be completely or partly excised according to its extent. Loose articular cartilage, both on the head of the femur and on the acetabulum, can be removed and the diseased bone beneath subjected to local disinfection.

From these observations it would seem that in many cases of tuberculosis of the hip, synovitis with effusion is present early in the disease; in a number of cases the capsule ruptures and extra-articular abscesses form. An anterior arthrotomy, if performed before rupture takes place, would effectually prevent this complication.

In three of our Cases, Nos. V, VII and VIII, extra-articular abscesses were present at the operation. The joint capsule in these three cases was not distended but perforation and communication with the abscess cavity were found in each case. In addition to the incision of the abscess, the joint was opened by the usual anterior incision and drained. In Case VII there were two abscesses; the one beneath the adductor muscles, on the inner lateral surface of the thigh was drained through the joint capsule. Microscopic examination of the wall of abscesses from tuberculous bone, demonstrates, especially early in the disease, that the wall of such "cold" abscesses is composed of ordinary granulation tissue. We seldom find evidence of tuberculosis. Clinical observations demonstrate that extensive excisions of the abscess wall are not necessary. The most important point in the treatment is the removal of the source of infection in the bone. For this reason in operations for tuberculosis of the hip in which extra-articular abscesses are present, I believe it is better in every case to simply incise the abscess, curetting and thoroughly disinfecting in addition, if you wish, but most important of all in every case to explore the joint and search for the focus of tubercular osteomyelitis. We however, will have to wait before forming definite conclusions, and compare the immediate and ultimate results in these cases with those in which the extra-articular abscesses have simply been incised. Recent observations, however, have impressed me with the value of early exploratory arthrotomies in tuberculosis of the hip, not only for a confirmation of the diagnosis early in the disease, but for treatment.

In all the joints, especially the hip and knee, the synovial sac can be thoroughly disinfected and filled with iodoform, and with a small chisel the more common positions for the tubercular focus can be explored. To open and irrigate a normal joint, even with 1:1000 bichloride of mercury solution, is not followed by any restriction of motion, and Case I demonstrates that the hip joint can be drained for six weeks and yet almost complete restoration of the function result. Anterior arthrotomy of the hip is a simple operation and its dangers should be confined almost entirely to the danger of the anæsthetic. However, it must always be borne in mind that a virulent pyogenic infection of the wound at the operation or later would be a serious complication, and if we found that this occurred with any degree of frequency, it would most certainly detract from the results, even in comparison with the orthopedic treatment. More extended experience will be necessary before we can judge of the risk of infection. (There has been no infection in our series of 12 cases.)

The anterior incision in cases of tuberculosis of the hip is not a new procedure. Mr. Barker (*Manual of Surgical Operations*, 1887) describes it as R. W. Parker's operation. More recently, in Treves' *System of Surgery*, Mr. Barker again gives this incision first place, and in addition states that Professor Hueter, of Greifswald, described a similar method independently but at about the same date of Mr. Parker's. (*Transactions of Clinical Society of London*, 1880, page 105.) Bradford and Lovett (*Orthopedic Surgery*, second edition, 1899) describe the anterior incision for the excision of the joint, but prefer the posterior incision. As far as I am able to find in the more recent authorities, the suggestions made and the methods followed in these cases are sufficiently original to justify their publication.

To repeat, the chief object in the early operation for tuberculosis of the hip is to take the disease in its early stage, to relieve the tension of the distended capsule, to check and cure the tubercular synovitis by disinfection and drainage, to explore the bone with the hope of finding the tubercular osteomyelitis, in which case it can be partially or completely excised; trusting also to disinfection, drainage and the healing process to check and later cure the disease of the bone without injury to its continuity. The acetabular cavity can be explored, as shown in (Fig. 5b) by chiseling through the head; more extensive operations on the acetabulum, however, could not be performed without removal or temporary dislocation of the head. It is too early to judge of the results, except in Case I, in which the patient has now a perfectly functional joint one year after operation.

In operations for tuberculosis of the joints, one must always bear in mind the possibility of disseminating the tubercle bacilli. In operations on joints where the Esmarch can be used, this danger may not be as great as in operations on the hip and shoulder. It will require, however, a number of years and careful observation to get at data for this study. The method of operation is clearly described in the details of the history of the nine cases reported. The most important anatomical point is to bear in mind the deep external circumflex vessels. Sometimes it is not necessary to divide these, but if it is found that more room is required, these vessels should

be carefully ligated. The joint can be exposed easily without dividing the muscle by separating the tensor vaginae femoris and the glutei muscles on the outer side and the sartorius and rectus to the inner (medial) side. I believe it is a better plan to lengthen the incision rather than to make a cross cut of the muscles. The separation of the muscle leaves a cleaner and a less ragged wound, and perhaps detracts much from the danger, not only of pyogenic infection but of tubercular dissemination. Through this wound, by separating the muscles, one can clearly see the capsule of the joint and the trochanter and upper portion of the shaft of the femur. On dividing the capsule, one can explore with great ease the neck and head of the femur. In these operations the head has not been dislocated from the acetabular cavity, but if one found the round ligaments destroyed, with extensive disease of the head and acetabular cavity, the head of the bone could easily be temporarily displaced to allow a better treatment of the head itself and the acetabular cavity, after which it could be replaced. This course was followed in a recent case by Professor Halsted.

DISCUSSION.

DR. HALSTED.—To indicate what we may hope for as a final result in certain cases of hip-joint disease, even when a considerable portion of the head of the femur has been removed, and in support of what Dr. Bloodgood has said, I will refer very briefly to a case which I intend very soon to report in full with other interesting hip-joint cases. The patient, a boy, thirteen years old on admission, had an acute osteomyelitis in 1895, at the age of eleven, which involved the entire diaphysis of the right femur. Eleven months he spent in bed, and for seven months could not lie on the affected side. After walking about with a cane and without much pain for more than a month he had to take to his bed again for about a week during a second acute attack of pain in the same bone. Two or three months later two abscesses appeared, one behind the knee and one internal to the trochanter. The boy was thenceforth for nearly a year quite comfortable and considered himself sufficiently well, until the 1st of November, 1897, when he was hit in the right groin by a wagon-pole. He suffered greatly from this blow, and the following morning could not flex his thigh. Two weeks later, November 19, 1897, he was brought to us by his physician, who stated that for several days he had been having very high fever with daily intermissions. The boy was emaciated; his expression anxious and indicative of suffering. He lay on his back; the right thigh was abducted, rotated outwards and slightly flexed; the groove in the right groin was obliterated and there was an appreciable fullness over the head and neck of the femur. Pressure over the joint and all attempts to move the head of the femur caused pain. About the level of the top of the trochanter of the right femur, but internal and anterior to it, was a sinus from which pus escaped. Behind the inner hamstring tendons was the orifice of a second sinus discharging more pus than the other. The femur was much enlarged, and the soft parts of the thigh were swollen. An involucrum had evidently replaced the entire diaphysis. A probe in the popliteal sinus touched rough bone. The measurements, which developed a fact or two of interest, I will give at another time.

1st Operation. Nov. 24, 1897.—EXCISION OF ONE-HALF (ANTERIOR) OF THE HEAD, NECK AND UPPER PORTION OF TROCHANTER OF THE RIGHT FEMUR BY FRONTAL SECTION. There was a small abscess containing only a few drachms of pus just below and in front of the capsule of the hip joint, which communicated with this joint. The wall of the abscess was carefully excised. Having made the frontal section of the trochanter, neck and head of femur, the extent of the disease in these parts could be accurately determined. The upper end of the soft sequestrum was cut off. The disease had involved the neck and head and had finally, perhaps just after the blow from the pole, infected the hip joint. By some oversight no drawing was made of the lesions in the head, neck and trochanter. Nowhere were there signs of active bone disease; there was a little sequestrum near the top of the trochanter, and a little, very slender bit of sequestered bone in the neck; the shape of the head and of the neck was not altered by the disease; the head of the bone had lost some of its cartilage, and granulations were growing from the denuded parts. The infection of the joint was probably recent, and it could be demonstrated how this might have taken place. It was not contemplated at the outset to do more at the first operation than to relieve the trouble about the hip joint, for the patient's condition contraindicated an extensive operation. The patient recovered promptly from this and from two subsequent operations upon the middle and lower thigh. As you may see in the photographs, the boy can extend his thigh perfectly, and can flex it to nearly a right angle. He walks without a cane and says that he finds the right thigh as useful as the left. The operated thigh is from 1 to 1.5 cm. longer than the other; and there are 2 cm. of apparent

lengthening on the right or operated side. This apparent lengthening is due in part to abduction and will undoubtedly disappear.

This case sheds a new light upon the surgery of the hip-joint, proving as it does that not only a useful but functionally an almost perfect joint may be obtained even when one-half of the head and neck of the femur have been removed by, approximately, a frontal section. We may, therefore, attack tuberculous cases in the early stages in some such conservative way, taking a fine and very thin slice from the anterior surface of the neck or head, or trochanter, or from all, and having located the disease, excise only as much as may be necessary. The acetabulum can be explored in a similar manner. If the disease is operated upon early it would probably rarely if ever be necessary to remove the whole head of the femur; and we may find that having removed a part of the disease the remainder, as in tuberculous peritonitis, may take care of itself the better for having been interfered with and assisted.

The hip joint, a simple ball and socket joint, promises more for these conservative operations than any other joint; large surfaces covered with cartilage do not lend themselves so readily to the formation of strong adhesions and ankylosis as the less simple joints; of all the joints the knee is perhaps the least suitable for conservative surgery. With its ligaments and reduplication of synovial membrane, with its fibro-cartilages and numerous recesses and pockets it furnishes conditions well suited to the propagation of the tubercle bacillus; and when the crucial and lateral ligaments have been much weakened by the disease, an ankylosed joint is usually more serviceable and more comfortable than one in which motion has been secured.

GUNSHOT INJURIES BY THE WEAPONS OF REDUCED CALIBRE.*

BY L. A. LAGARDE, *Surgeon, U. S. A.*

My first acquaintance with the military weapons of reduced calibre dates from a time when I was pursuing studies with firearms in this institution. I am, therefore, very happy to return here to-night to talk of guns and missiles with you.

In considering the effects of the modern arm, experimenters have generally studied it by comparison with the older weapon. I hold in my hand the Springfield rifle, calibre 45, which was used by our foot troops from 1874 to 1892. It is a single loader and in expert hands it is capable of delivering 20 shots per minute.

Its projectile has a velocity of translation of 1301 f. s., a velocity of rotation on its long axis of 800 turns per second, and a maximum effective range of almost 2000 yards. It is made of lead hardened with antimony, cylindro-conoidal in shape, weighing 500 grains, and is propelled by 70 grains of black powder.

I will now exhibit our present service rifle—the Krag-Jorgensen—adopted in 1892 for use by the foot troops. It is

a typical example of the reduced-calibre weapons at present in use by all the powers. It is provided with a magazine which holds five cartridges. In expert hands it is capable of delivering as many as 40 shots per minute. Its projectile weighs 220 grains, 30 calibre, composed of a nucleus of lead, enclosed in a hard steel mantle. Its velocity of translation is 2000 f. s., the velocity of rotation 2400 turns per minute; whilst it possesses a maximum effective range of 4000 yards, propelled by 37 grains of smokeless powder.

In some experiments which I conducted in 1892 at Frankford Arsenal, under the orders of the Secretary of War, my efforts were especially directed to the difference in destructive effects between the missile of the 45-calibre weapon, and that of a missile so similar to the Krag-Jorgensen bullet, that for all practical purposes they may be regarded alike.

We fired the two bullets altogether one hundred and ten times, into ten cadavers. Our aim was to traverse similar parts of the body or parts offering about the same resistance, with first one and then the other bullet at all the ranges—from 100 to 2000 yards. The ranges were not actual; they were simulated by reducing the charge of powder so that the projectile was

*Read before the Johns Hopkins Hospital Medical Society, Nov. 10, 1899.

given the remaining velocity which was common to it for any given range.

Impact.—The first thing to attract our attention at the outset of our experiment was the difference in the amount of shock imparted to a member when hit first with one and then with the other bullet. The shock was estimated by the oscillation of a limb when suspended. As might have been expected, the greater sectional area and greater weight, of the 45-calibre projectile, caused greater shock than that noted by the smaller and lighter bullet on impact with a resistant bone. Indeed, the difference was so marked that it often happened that the presence of a fracture from the latter was only noticeable upon close inspection, whereas it was invariably predicated by the motion imparted to the member when traversed by the larger bullet. The shock from either bullet as judged by the motion to the limb, was nil when soft parts alone were hit.

The minimum amount of shock from the smaller calibre bullet has been the cause of much concern among military men. The English in the Soudan, and in the Ashanti campaign were so doubtful of the efficacy of this small calibre missile to arrest the impetus of savage tribes that they resorted to the practice of making their missile explosive by filing the nose through the steel casing enough to expose the lead core. This is the famous Dum-Dum bullet which takes its name from the place of its manufacture in India. When the lead is exposed, as stated, the projectile disintegrates on impact with a resistant structure. The fragments of the steel mantle and lead core, acting as individual missiles add greatly to the destructive effects in the foyer of fracture.

Explosive Effects.—Our observations with the old and new rifles were next directed to explosive effects. We noticed these so-called explosive effects with the new weapon up to 350 yards, whilst they were seldom exhibited with the old arm beyond 200 yards. Explosive effects in gunshot wounds are peculiar to rifle projectiles impressed with high velocities. Within the zone of explosive effects they are common in the experience of the military surgeon, whereas they are seldom witnessed by the civil surgeon whose experience is almost entirely confined to wounds by pistols, whose projectiles are possessed of comparatively low velocities.

In speaking of explosive effects, one should not confound the term *explosive effects with explosive action*. The latter term should be restricted to those wounds caused by an explosive bullet—that is, a projectile that explodes on impact. Such a projectile is hollow, charged with explosive materials which ignite when the bullet strikes against a hard substance, like bone. The bullet is thus torn asunder, causing usually an extensive lacerated wound. On the other hand the projectiles possessed of superior velocities do not explode on impact. They are solid, and at most, seldom become altered in shape. Indeed, those of the small calibre, enclosed in a mantle of the hardest steel, do not even deform when they collide with the most resistant parts of the human body; and yet they are proverbial for their explosive effects in the proximal ranges.

Explosive effects are well exhibited by firing the projectile of the old and new arm into tin cans at close range. For the

purpose of comparison, if the experiment is done by firing into tins when empty, and into another set of tins of similar capacity filled with water, the empty cans will exhibit no alteration in shape. The orifice of entrance and exit of the bullet will correspond in size to the sectional area of the projectile; on the other hand the tins that were filled with water will show great alteration in shape. The sides of the vessels will exhibit a bulging as if some interior force had exerted an outward pressure in all directions. The orifice of entrance will usually correspond to the calibre of the projectile, whilst the orifice of exit will be marked by a large irregular opening with everted edges.

If the experiments are continued upon a cadaver at close range, impact with a resistant bone will present certain characteristic features: The wound of entrance in the skin will correspond in size to the diameter of the bullet; the wound of exit will be marked by a bursting forth of the skin. "The track leading to the bone is conical in shape, the base of the core corresponds to the wound of exit in the skin, and the apex of the core corresponds to the seat of fracture. The bone is finely comminuted. A close inspection shows that the bony particles have been driven into the tissues at right angles to the bullet track; it is not uncommon to find bony sand in the wound of entrance."

Five theories have been advanced to explain these explosive effects.

1. Hydraulic Pressure.
2. Compressed air, or the projectile air.
3. Rotation of the bullet.
4. Deformation of the bullet.
5. Heating of the bullet.

1. *Hydraulic Pressure.*—The term "hydraulic theory" has been employed by many writers to explain the highly destructive effects often found in gunshot wounds at the proximal ranges. It is based on the principle of Pascal. This principle is only applicable to a closed vessel filled with liquid. In accordance with this principle if a certain pressure is made upon a given area of the imprisoned liquid a similar pressure will be exerted within on like areas of the vessel walls.

The experiments of Coler, Stephenson and others have effectually disproved this so-called hydraulic theory. They have shown that the highly destructive effects noted by firing into sealed vessels filled with liquid were to be noted in the same way when the vessels were unsealed. Ordinary tin buckets filled with water whether the tops were in place or not sustained the same amount of destruction.

2. *Compressed air, or projectile air.*—This is called the projectile air of Melsens, because it is he who recently revived this theory of projectile air in explanation of the destruction in wounds that so often suggest explosive action. Boys has succeeded in making exact photographs of bullets in transit. He caused the bullet to cross an electric circuit. At the moment of contact with the circuit the bullet and the immediate vicinity of its trajectory are illumined by a spark which serves to throw the image upon a photographic plate. A study of the views thus obtained distinctly shows a pad of compressed air in front of the projectile. Melsens believed

that this cushion of air entered the tissues at the moment the skin was penetrated or before, and that the destruction of tissues was to be accounted for by the explosion which occurred when the compressed air again regained its normal volume. The tissues fail to show any evidence of air having been forced into them, such as one might infer from the presence of emphysema, and altogether it may be said that the theory of projectile air has but little to recommend it to consideration.

3. *Rotation of the bullet.*—The rotation of a rifle bullet is imparted to it by the twist in the barrel. The longer the bullet the sharper must the twist be. The old Springfield 45-calibre bullet, which was but two calibres in length, and which revolved 800 turns per minute at the muzzle described one complete turn in 22 inches, because the twist in the barrel corresponded to one complete turn in 22 inches. In the present rifle the twist is sharper, viz., 1 turn in about 10 inches, and the rate of revolution is estimated at 2400 turns per minute. It is generally admitted by ballisticians that the velocity of rotation is well maintained,—that it does not diminish with the velocity of translation. Taking for granted that the projectile makes a complete turn in ten inches, we must admit that the rotation of the bullet can have but a minimum amount of effect to display in traversing a thigh bone which may be but one inch in diameter, because in traversing it the ball is making only $\frac{1}{10}$ of a turn.

4. *Deformation.*—The fact that the old leaden bullet became deformed when colliding with a resistant bone, especially at short range, added greatly to the amount of destructive effects. Deformation can find no plea as a cause of destructive effect in all cases since the steel-clad bullet that does not deform is proverbial for the creation of explosive effects.

5. *Heating.* Heating of the bullet by the act of ignition to explain explosive effects found adherents long ago, and it was not until recent years that this erroneous notion was set aside. It is not necessary to explain to an audience like this in the very institution where the significance of heat imparted to missiles was forever determined. We were able to show in 1892 that the heat on a bullet caused by the ignition of the powder is not sufficient to destroy the ordinary septic germs. The experiments were conducted with missiles from low-velocity rifles and the weapons of reduced calibre with the same result. To speak briefly we can truthfully say that the heat of a missile cuts no figure in gunshot wounds.*

The true cause of explosive effects is the superior energy possessed by the bullet at the moment of impact. The bone, and even the soft parts, receive a large amount of this energy and move "outwards in lines radiating from the long axis of the bullet-track with such a degree of force that they act as secondary missiles on the neighboring tissues and cause still further smashing and pulping of the tissues. Even fluid particles participate in this secondary action but it is all the more marked when fragments of bone are driven apart in this manner." (Stephenson.)

Soft Parts.—Our next experiment at Frankford with the

small-diameter bullet demonstrated that the wound of entrance was usually round, the size corresponding to the diameter of the bullet; the edges of the wound were at times clear cut, but more often they were rolled in and often blackened like the wound of entrance of the old leaden bullets. This, as you know, once gave rise to the idea that the edges of the wound were discolored by burning; but thanks to the assistance of Professors Welch and Councilman, as already stated, this idea was refuted for all time in the laboratory of this institution.

The wound of exit of the small-calibre bullet was generally larger than the wound of entrance, and beyond the zone of explosive effects especially it was generally round, marked at times by a mere slit; again it was star-shaped, T-shaped, semicircular, &c.; the edges were generally turned out.

Diaphyses of long bones.—Our next observations at Frankford Arsenal referred to the effects of the small-calibre bullet upon the compact substance of long bones. Here I may state that the destructive effects of the old and new bullet up to 350 yards were alike, and severe. Beyond 350 yards the lesion in the bony tissue changed perceptibly with the smaller bullet, the comminution was less, the fissures were larger, and the spiculæ of bone were not so often detached. The general tendency with the little bullet between 500 and 1500 yards was to inflict a wound approaching a perforation, although a clear-cut perforation in the diaphysis itself was seldom seen. At 2000 yards the small bullet showed a tendency to again shatter the bone.

Effects upon the epiphysial ends of long bones.—Clear-cut perforations were generally observed when the small bullet traversed the spongy ends of bones. This was especially true after the zone of explosive effects and even within this zone—350 yards—complete perforations with little or no fissuring were often seen.

Actual Conditions.—Of the wounds noticed in Cuba during the Santiago campaign I may add that they partook the general characters of the wounds that I have described as experimental wounds. The wounds of the soft parts healed immediately, without an exception to my knowledge, under antiseptic dressings. The wounds of joints, including the knee, elbow, shoulder and hip were immobilized, dressed antiseptically, and they all did well. The wounds of the skull, including brain substance almost invariably suppurred, owing no doubt to the amount of dirt introduced from the scalp with the bullet.

Wounds of the lungs.—Those that survived 24 hours generally did well. In the majority of instances it was difficult to restrain the men after two or three days.

The wounds of the abdomen were generally fatal. Four or five men recovered with gunshot wounds that appeared outwardly to have perforated the intestines, but no actual proof of such perforation was obtainable. I was told that three laparotomies for gunshot injury of the abdomen were done at one of the field hospitals. The patients all died in a few hours after operation. For many reasons laparotomy for gunshot wound in the abdomen on the field was not considered safe or practicable. Upon the whole, the gunshot injuries by the Mauser, the reduced-calibre rifle of the Spaniards, were in keeping with those humane effects so confidently predicted by

* Proceedings Pan American Congress for 1893, Vol. 1. N. Y., Med. Record, Vol. 47, No. 25.

experimenters generally. The wounds of soft parts healed without suppuration. The lesions of bone that formerly caused such a high mortality in the statistics of wars were most successfully treated by antiseptic dressings and the proper use of immobilizing materials. Comminution, and fissuring were noticed in the diaphyses. It was, however, seldom necessary to cut down for the purpose of removing spiculæ of bone, as the displacement of fragments did not require this amount of interference. The clean-cut perforations of the epiphyses, without fracture, rendered joint injuries the most favorable of all bone lesions for rapid healing, with little or no loss of function. This was especially true of gunshot wounds of the knee.

The difference between the gunshot wounds of civil and military hospitals will be more marked in the future. The civil surgeon will continue to treat pistol-shots in which the balls often lodge. Some lesions from this source often show complete separation of fragments, which necessitates cutting down. The joint lesions are often severe, necessitating the opening of the joint, under antiseptic precautions, turning out blood clots, removing fragments, etc. Such precautions are necessary to insure against sepsis. On the other hand, it may be said that the action of the steel-clad bullets from the present military weapons and the use of antiseptics have so modified the results in the gunshot wounds of warfare that the burden of the military surgeon and the sufferings of the patient, immediate and remote, will be very much lessened.

DISCUSSION.

EXHIBITION OF RADIOGRAPHS SHOWING RESULTS OF SMALL-CALIBRE INJURIES.—DR. W. C. BORDEN, U. S. A.—During the late war I was stationed at Key West with an X-ray machine, and from a study of the wounded soldiers I have arrived at some general conclusions relative to the effects of the small-calibre bullets on the human body, more particularly upon the bones. Dr. LaGarde has gone over the consideration of the theoretical effects of the bullets and these pictures will show the clinical effects as demonstrated by the Roentgen ray.

It seems to me that there are four main elements that influence the effect upon bone tissue—(1) the velocity of the bullet—(2) the part of the bone struck—(3) the angle of incidence and (4) the form of the bullet. Clinically, there is one thing above all others that affects the course of the case, and that is the presence or absence of sepsis in the wound.

When the bullet is traveling at extremely high velocity the explosive effects are produced whether the bullet strikes the bone, I mean now the shaft of the bone, at any angle or in any part. For instance, if it strikes the bone perpendicularly, it will produce a bad fracture, and it will do this equally if it merely grazes the bone. When the bullet strikes the bone laterally, merely grazing the periosteum at a high velocity, it produces a fracture that may be termed a fracture by contact. Here is an illustration (showing radiograph); the bullet passed across the front of the forearm, just grazing the radius, and yet, as you see, it shattered the bone completely; and here is an example showing a similar effect upon the hand at short

range. In this case the whole distal end of one of the metacarpal bones has been blown completely out, and yet the wound of exit was very little larger than the wound of entrance; the range was five hundred yards.

So much for the effect upon the human body when the velocity of the bullet is at its greatest. Now, the angle of incidence seems to me to have a marked influence. When the bullet strikes the bone in the median line with perpendicular impact, it shatters the bone as badly as if it were within the explosive range. Here is an illustration of a fractured thigh, in which the bullet went straight through, striking the femur with a median impact, and you see how badly the femur is shattered. In a little over a year after the injury I radiographed this same case; the wound had healed readily without any suppuration, and though there is a tremendous callous formed about the fracture, the position and function of the limb are almost perfect. Now as to tangential impact, when the bullet strikes the bone at an angle the fracture and fissuring are not so great, no matter what the range may be, provided it is outside the explosive zone. In this case (showing radiograph) the bullet struck the outer side of the radius, tore off a piece of bone and made a straight fracture.

Now as to the form of the bullet. Dr. LaGarde has spoken only of the bullet as it strikes after passing through the air; but in war it may ricochet, strike some object, become deformed and then strike the body. In these cases the effect of the bullet is decidedly different from that of the plain undeformed bullet. In this case (showing radiograph), for instance, the bullet struck some object before it hit the man, and the whole end of it became flattened so that it was practically like a Dum-Dum bullet. The velocity was low, for the bullet lodged in the tissues and yet because of its extreme deformity when it struck the bone it shattered it immensely. Here is an injury of the same class showing two bullets in the same limb. Both bullets were deformed and the shattering was very great. Here is a photograph of several Mauser bullets removed after X-ray examinations of the patient. All but one of them are deformed.

Here is a rather interesting radiograph showing the passing of a Mauser bullet through a phalanx. The bullet is so small and travels with such velocity that it may pass through a finger and not tear it off as would a larger bullet. Relative to this case I would say that gunshot injuries of the hand always cause some permanent loss of function. This is due to injury to the soft parts; and in regard to injury to the soft parts by the small-calibre bullet I would say that we have had a great many cases where, though the bones were markedly shattered, if the soft parts were not much torn there was not much loss of function; but if the soft parts were greatly disturbed, the resulting cicatrizing tissues caused considerable disturbance of function.

The injury produced by these bullets to the ends of long bones is quite different from that of the shafts. In the shaft the fissuring and comminution are always greater than in the extremities. Whatever the theory of explosive effect may be it is certainly true that the dense tissue of the shaft transmits the shock more than the softer tissues and causes greater solution of continuity.

Concerning the humane effect of these bullets I should say that where they do not kill outright they are certainly much more humane than the old bullets were. I saw some cases,—one I remember in particular—where the bullet passed through

the abdomen, directly through the liver, and yet the patient was up and ran away from the hospital eleven days after receiving the injury.

A RECONSTRUCTION OF A GLOMERULUS OF THE HUMAN KIDNEY.

BY WILLIAM B. JOHNSTON.

(From the Anatomical Laboratory of the Johns Hopkins University, Baltimore.)

WITH SIX FIGURES.

Since the appearance of Carl Ludwig's article upon the Kidney in 1872,* in which he devotes but a few words to the structure of the glomerulus, and in which are reproduced a few drawings of the glomeruli of mammalian kidneys, other investigators have been inclined to pass over this part of the vascular mechanism of the kidney, mentioning only its afferent and efferent vessels. The difficulty of seeing anything but the exterior of a glomerulus has, of course, always obscured its intimate structure. For these reasons it has appeared advisable to make a more careful study of the arrangement of the blood-vessels of the glomerulus by means of the method of reconstruction.

The requirements for such a reconstruction are a perfect set of serial sections through a well injected glomerulus, the sections being thin enough to pass at least twice through any of its vessels which may be struck parallel to the plane of cutting, as well as a conception of the outward form of the glomerulus previous to cutting.

Preliminary injections of the dog's kidney with a variety of substances brought out the advantages of a supersaturated aqueous solution of Berlin blue over other injection masses, and the advisability of selecting and cutting a single glomerulus. Adult human kidneys from the autopsy table were usually abnormal and always failed to be well injected. In order, therefore, to obtain a good injection of a normal glomerulus, the kidney of a child three months old, dead but a few hours, was injected in situ through the abdominal aorta until the Berlin blue appeared in the renal vein. The difficulty of obtaining a faultless series of very thin sections was greater than that of selecting and cutting out a well-injected glomerulus from clear bits of this kidney, though very many seemingly perfect glomeruli proved to be but partially injected. A chosen glomerulus from the child's kidney was imbedded in paraffin in the usual way and cut into serial sections $3\ \mu$ thick. The 34 sections through this glomerulus were then stained in Upson's carmine and mounted in balsam. Drawings of each of these sections enlarged 1333 diameters, the greatest convenient enlargement, were made with a camera lucida (Figs. 4, 5, 6) and the corrected drawings transferred with carbon paper to wax plates 4 mm. thick, *i. e.* 1333 times as thick as the original sections.

Before beginning the reconstruction, that part of each plate representing the glomerulus proper was cut out, the line of incision following the outer borders of the external vessels, leaving Bowman's capsule in the outer shell. The remaining wax shells thus obtained were carefully piled in order, and a plaster-of-Paris cast made of the cavity. The solid cast roughly indicated the external form of the enlarged glomerulus. As a further guide to the reconstruction, the sections of the blood-vessels appearing in each plate were cut out with the exception of wax bridges connecting them. The internal relation of these sections in wax representing the blood-vessels was thus preserved, which aided materially in piling and blending the individual sections.



FIG. 1.—Wax model of the glomerulus, enlarged 444 diameters, seen in profile from the left side. *A V* afferent vessel; *E V* efferent vessel.

From the model thus made it appears that the afferent vessel of the glomerulus, after entering the capsule of Bowman, immediately divides into five diverging branches, which with their subdivisions and with the efferent vessel form an almost spherical tuft of blood-vessels. For the sake of description we may assume that the glomerulus is suspended from its afferent vessel. The efferent vessel originates, roughly speaking, from a loop of capillaries which projects in the equatorial plane from the side of the glomerulus opposite the afferent vessel, but to the right of the median line (Fig. 2 *E. V.*). From this point the course of the efferent vessel is upward, inward, and to the left, grooving the superior surface of the glomerulus and dividing it into two unequal parts. This vessel leaves the glomerulus a little superior and

* Handbuch der Lehre von den Geweben des Menschen und der Thiere. S. Stricker, Vol. 1.

anterior to the point where the afferent vessel divides and in a direction opposite to that of the efferent vessel. (Fig. 1.)



FIG. 2.—Wax model of the glomerulus, same enlargement and same view as in Fig. 1. The left lateral group of capillaries is separated from the median group and turned back, exposing the interior of the glomerulus, *a*. A short section of a capillary of the median group is removed to show the course of the deeper-lying capillaries.

Externally the upper half of the glomerulus is seen to be composed of freely anastomosing capillaries, somewhat more pronounced on the left than on the right side. The capillaries of the lower half, except on the posterior surface, are longer and more direct. The projecting loop of capillaries mentioned above, the course taken by the efferent vessel within the glomerulus, and the tendency of many of the external capillaries to turn towards the right side, give the glomerulus the appearance of being twisted to the right. Except on the superior surface where the left half is a little above the right, the spherical form is well preserved. Lobulation where it appears at all is superficial. (Fig. 1.)

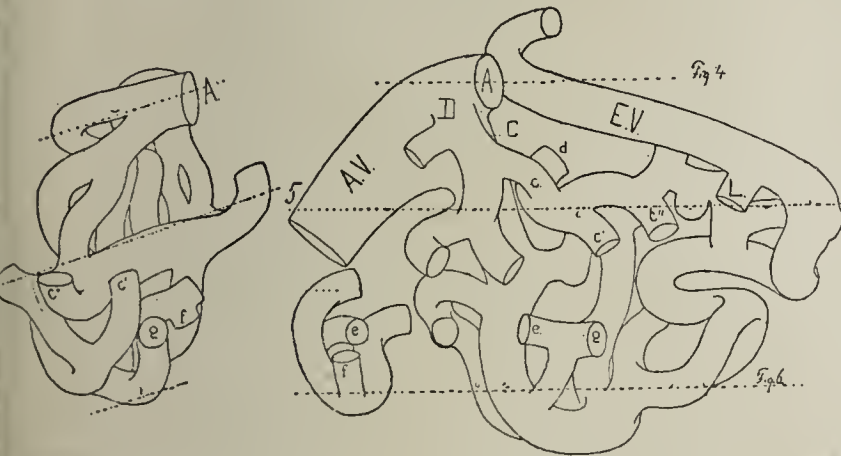


FIG. 3.—Diagram of the wax model seen from the left side. Enlarged 444 times. The right lateral group of capillaries is turned back from the main group. The group *E F* is a connecting loop turned over to expose deeper capillaries. The lines marked Figs. 4, 5 and 6 indicate that Figs. 4, 5 and 6 are taken from those planes, representing sections 7, 17 and 30 respectively of the original series.

The capillaries of the glomerulus can be roughly divided into a right, a left and a median group, corresponding to a right branch (Fig. 3 *A*), a left branch (Fig. 2 *B*) and a median branch (Figs. 2-3 *C*) of the afferent vessel. Two additional branches, a right lateral branch (Fig. 3 *D*) and a

left lateral branch (Fig. 2 *E*), take part in the formation of the lateral group of the corresponding side and of the median group. All five branches arise from the afferent vessel at the same time though at different angles. The distances between their points of origin are not the same. According to Ludwig, the glomerulus is composed of from 4 to 8 groups of blood-vessels.

Each main branch from the efferent vessel subdivides almost immediately. Each of the two lateral branches (*D* and *E*) has three subdivisions which are soon lost in the three main groups. They have in general the same arrangement.

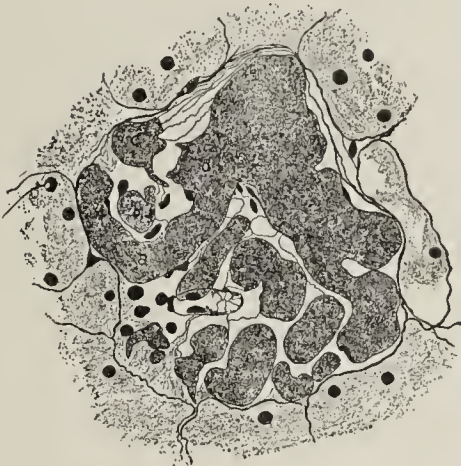


Fig. 4.

In the upper half of the left group (Figs. 1-2) there is a complex network of anastomosing capillaries. In the right group (Fig. 3), which is smaller than the left group and lies at a lower level, the course of the capillaries is more direct.



Fig. 5.

FIGS. 4, 5 and 6.—Camera tracings of sections 7, 17, and 30, showing the capillaries, reticulum nuelei and Bowman's capsule. Enlarged 444 diameters.

The capillaries of the median group nearest to and farthest from the origin of the median branch (*C*) are in general longer and freer than those of the other group. The intermediate capillaries are short and the anastomoses frequent.

In addition to the many connections between capillaries of the same group, the three groups or lobules are intimately connected with one another by numerous anastomoses. The capillary connections between the median group and the right group on one hand (Fig. 2) are of the same frequency, although unlike those between the left group and the median group on the other hand (Fig. 3). At one point there is an anastomosis of all three groups (Fig. 2 *d, d'*, Fig. 3 *d, c, c', c''*). The number and varied character of these connections show the impossibility of dividing the capillaries of the glomerulus completely into distinct groups.

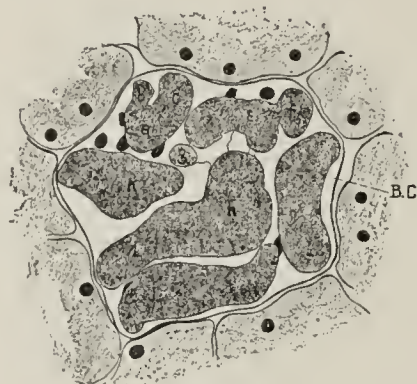


Fig. 6.

Through the divisions of the main branches of the glomerulus and their subsequent anastomoses, all the capillaries are concentrated at two distinct levels (Fig. 2 *F, G*) in the median plane opposite the afferent vessel. Though the formation of the efferent vessel is clearly indicated at each level in the sections, it cannot be said to actually originate until the last capillary from the glomerulus has united with it (Fig. 3 *L*).

It is seen that the blood in passing from the afferent to the efferent vessel has the choice of numerous paths of varying lengths. The shortest path is that from the right lateral branch of the afferent vessel just above the central point of the glomerulus and in the median line (Fig. 3 *D, c*). Passing outward from this point to the periphery of the glomerulus, the paths become longer and more complex. The longest path is that of the median branch and its subdivisions along the inferior surface of the glomerulus. It is three times as long as the shortest path (Figs. 2-3). Yet the shorter course is

zigzag and is composed of the smallest capillaries. As the course between the afferent and efferent vessel becomes longer and longer, the capillaries become straighter and larger, thus correspondingly favoring the blood circulation through them.

The afferent vessel is larger than its branches, especially just before the point of division; the branches are larger than their subdivisions. The efferent vessel is of the same size as the main branches of the afferent vessel. The increased diameter of the afferent vessel and its first branches is no doubt due to the pressure in the artery when the glomerulus was injected. Excluding this factor it is probable that the diameter of the various vessels of the glomerulus is the same from the afferent to the efferent vessel.

The very fine serial sections of the glomerulus not only served as a basis for the reconstruction of the blood-vessels, but also enabled me to study more carefully the relation of Bowman's capsule to the glomerulus. Ludwig* has shown that the basement membrane of the uriniferous tubules is elastic and when treated with reagents is very likely to swell. Later Mall† showed by digesting frozen sections of various organs with pancreatin that the interstitial tissue and so-called basement membranes resolved themselves into fibrils, showing some characteristics of yellow elastic tissue, some of white fibrous tissue and some peculiar to themselves. This set of fibrils (reticulum) is widely distributed and makes up the main framework of the kidney. It is these fibrils of reticulum which form the basement membrane of Bowman's capsule.

As the afferent vessel pierces Bowman's capsule, the reticulum fibrils forming it separate as shown in Figs. 4 and 5. They are not reflected over the glomerulus, but, at the point of separation, fibrils arise which penetrate the glomerulus passing in all directions between its capillaries. The fibrils are densest at the point these vessels penetrate the capsule and gradually become less and less numerous as the periphery of the glomerulus is approached. Up to the present I have not determined the nature of these fibrils but on account of their arrangement as well as the connection with them of Bowman's capsule, I do not hesitate to class them with the other reticulum fibrils.

* Ludwig, Stricker's Handbuch, 1871, p. 495.

† Mall, Abhandl. d. K. S. Ges. d. Wiss., Bd. 17, 1891; also Rühle, His's Arch., 1896, and Disse, Sitzungsber. d. Ges. z. Beförd. d. ges. Naturwiss. Marburg, 1898.

MEDICAL COMMISSION TO THE PHILIPPINES.

It is matter of general belief that scientists in the retirement of the laboratory pursue their abstruse investigations oblivious of wars, revolutions, and the manifold variations in the phases of international politics, and it is, perhaps, well on the whole that there is some basis for the belief. But, as a matter of fact, it will be found that the trend of scientific research is, at times, enormously influenced by changes in the outside world; for with these changes new problems arise upon the solution of which depends the ultimate success of national undertakings. No more striking example of such

influence could perhaps be adduced than the extraordinary attention which is at present being paid to the study of the causes, prevention and cure of diseases prevalent in the tropics. While there have been, it is true, notable instances of medical research prosecuted with brilliant results in tropical fields in the past, it is only since Northern and Western nations have turned their faces resolutely towards the South and the East—faces stern in the determination to hold their own in the fierce international rivalry for conquest and control of trade—that the importance of the medical problems

of the hotter regions of the earth has begun to be fully appreciated, and that organized bands of skilled investigators have been sent into them to study the diseases to which a large mass of their fellow countrymen will henceforth be exposed.

The earlier observations on the conditions and diseases of tropical countries we owe to missionaries and explorers, men of roving instincts and venturesome habits, who partly in self-defense, partly from desire to benefit other travelers or the natives of the regions traveled through, observed the sick and examined the methods of treatment in vogue in those lands. All such studies were necessarily fragmentary and of a desultory character, but no one with a knowledge of the subject would speak of them disparagingly, for they represent the beginnings of an important movement, and have been, moreover, attended by valuable discoveries, some of which have proved to be of the greatest benefit to humanity. It is only necessary to mention the introduction of cinchona bark into Europe in the 17th century by the Jesuits, who had seen its beneficial effects in Peru, and to recall the immense part played by its alkaloid, quinine, in the treatment of malarial diseases to-day, to realize the significance of at least one of these discoveries. Millions of lives have been saved, and whole continents made accessible to civilization, for the dangers of forest and morass have largely ceased to be prohibitive since the white man has learned to carry quinine in his blood.

Later, white traders and white soldiers, the natural successors of missionary and explorer, on entering the tropical regions took with them civil and military physicians, who by virtue of their better medical and scientific training were able to describe climatic conditions, investigate the symptomatology of diseases, and study their causes, nature and treatment far more accurately than their predecessors had done. Thanks to their efforts we are already in possession of an analysis of the more prevalent diseases peculiar to the tropics and of the many facts of importance concerning etiology, pathology, prophylaxis and cure. Among the most fertile in results has been the work done by Fayrer in India, and in Cochin China by Calmette, on snake poison; in Algiers by Laveran, and in India by Ross, on the malarial infections; in Bombay by Vandyke Carter and Obermeier, on relapsing fever; in China and other countries, by Manson, on filariasis; and in the West Indies and South America, by Sternberg, Guitéras and Sanarelli, on yellow fever.

During the last thirty years, however, remarkable advances have been made in pathological and especially in bacteriological technique. A large number of scientific investigators in all civilized countries have been gradually overcoming difficulties which had hitherto been insurmountable, but which, by the new methods at their disposal could now be satisfactorily attacked. The field of medicine has become so wide and divided into so many departments that one man can scarcely hope to cover all of them. Much as we have to thank civil and military physicians in the past for the good work they have done, we can scarcely ask in the future men who have to devote a large share of their time to the treatment of patients and to the performance of executive functions to undertake the complicated researches necessary for the

isolation of the causative agent in obscure diseases. There has to be a division of labor and the practical man must be helped out by individuals who have been especially trained in particular lines of work, and who can give all their time to such work. Accordingly, of late, European governments and educational institutions have been sending into tropical regions men especially prepared and commissioned to investigate disease, and these men have been relieved of all duties except those actually connected with their original research. In this way, Koch and Gaffky went to Egypt and India, in 1883, to study Asiatic cholera, an expedition which resulted in the discovery of the cause of the disease; and at Hong Kong, in 1894, Yersin isolated the bacillus of bubonic plague. That such special investigations of the causes of disease justify the education of specialists and the expenditure of the time and money required is fully evidenced by the practical results which have followed. Cholera, now that the spirillum, the growth and activity of which in human beings cause the symptoms of the disease, is known and its habits of life and mode of dissemination have been studied, can in civilized countries be absolutely controlled; the disease can no longer gain a permanent foothold in a city in which modern methods of sanitation are employed. Plague which swept away whole populations at a breath in former times need now scarcely be feared among Western nations; for even if the hygienic precautions of the end of the century fail to keep the disease out of the West, the method of preventive inoculation which has been devised since the discovery of the causative bacillus will protect those who avail themselves of this prophylactic measure.

In the light of these facts the authorities of the medical department of the Johns Hopkins University decided in March of the present year to send two of their staff, Dr. Simon Flexner and Dr. Lewellys F. Barker, to the Philippine Islands, equipped with a complete outfit for the study of disease by modern clinical and pathological methods. They were instructed to study the diseases which prevail in the islands "with the hope not only of making contributions to the science of medicine, but also of being of service to the American forces in those islands, to the natives of the country, and to humanity at large." The expenses of the expedition were defrayed through the generosity of a few friends of the University. Two advanced medical students, Mr. Joseph Marshall Flint, of Chicago and Mr. Frederick P. Gay, of Boston, went as volunteers and at their own expense to assist in the medical work at Manila. Mr. John W. Garrett, of Baltimore, interested in the political relations of the archipelago, made a fifth member of the party.

The voyage out was made by way of Vancouver, Japan and Hong Kong. Ten days were spent in Japan and the experience there proved of great value as an introduction to the work in Manila, inasmuch as Japanese scientists have studied and, indeed, with considerable success, several of the problems which confront the investigator in the tropics. With Doctors Aoyama and Miura in Tokyo, several cases of *kakke* were observed, a disease which in the Philippines and in other countries, is more generally known under the name of *beri beri*.

The researches of the Japanese into the nature of this malady are among the most interesting and important extant. Dr. Aoyoma, who when investigating plague in Hong Kong was himself attacked by the disease and for a considerable period lay in a most precarious condition, showed no ill effects of the ordeal passed through, but was as active and enthusiastic as ever in the observation and treatment of disease. In the laboratory of Dr. Kitasato, the celebrated bacteriologist, of Tokyo, opportunity was afforded for looking into the work done by Dr. Shiga, one of the assistants in that laboratory, on the cause and treatment of dysentery. Dr. Shiga, who has isolated a bacillus which he regards as the cause of epidemic dysentery in Japan, has also, by inoculation of the bacillus into animals, prepared a curative serum which he believes will be of value in the treatment of human cases.

At Hong Kong, the members of the Commission, through the courtesy of Dr. Lowson, had their first opportunity of studying cases of bubonic plague, clinically in the wards of the isolation hospital and pathologically in the dead-house. The disease is constantly present there, though to a varying degree, among the Chinese inhabitants, Europeans being occasionally, though but rarely, attacked. A member of the Commission, speaking of experience with plague, remarked upon the curious mental phases passed through on encountering for the first time such a world-dreaded disease. During the first visit to the morgue in which the dead bodies of plague patients were kept, great care was taken to come into no personal contact with the dead, and even draughts of air leading from the vicinity of the cadavers were avoided. On the second day, the swellings (or buboes) in the groin, axilla or neck were palpated, but with some care; and on the third day, they found themselves making post-mortem examinations of the internal organs. Though Dr. Aoyoma developed the disease as a result of his studies, and Dr. Müller, of Vienna, died from plague contracted while attending a nurse sick of it, it is probable that pathologists, provided they take the necessary precautions to avoid infection, have less to fear than is ordinarily supposed. If one work much with the disease, however, he would be very unwise did he not take advantage of the protection afforded by Haffkine's preventive inoculation.

The members of the Commission arrived in Manila at the beginning of May and at once, thanks to letters from Surgeon-General Sternberg, and the courtesy of Colonel Woodhull, the chief surgeon of the American forces in the islands, were enabled to begin their work in the military hospitals there. The majority of the American sick in Manila are cared for in two large base hospitals known respectively as the First and Second Reserve Hospitals. In the former institution, with Major Crosby in control, are some twelve hundred patients; while in the latter, under the management of Captain (now Major) Keefer, there are perhaps one-fourth as many. As soon as the patients are convalescent, those who require further building up are sent to the pleasantly situated Convalescent Hospital on Corregidor Island. This hospital is situated on the shore snugly nestled beneath the fort which fired on Admiral Dewey's ships as he entered Manila Bay. In addition to the military institutions men-

tioned, there are numerous "district" and "regimental" hospitals in Manila, Cavite and other places where American troops are stationed. It was a matter of pleasant surprise to see how efficiently large military hospitals, seven or eight thousand miles away from home, could be organized for medical and surgical work. Whatever criticisms may have been made in America with regard to the administration of military affairs, nothing but praise is to be recorded of the medical services rendered by Colonel Woodhull and his staff in the Philippine campaign.

On account of the especial facilities and material obtainable at the First Reserve Hospital, working headquarters were established there, Lieutenant Strong generously sharing his laboratory with the newcomers, and in every way possible, lending his aid to the investigations undertaken. The time at their disposal being limited, the members of the Commission decided to choose, out of the many attractive problems which immediately suggested themselves for investigation, certain only which seemed to them of the greatest importance and which could be most advantageously approached. It was found that among the American soldiers in Manila the two most fatal diseases in May and June were dysentery and typhoid fever, while among the natives tuberculosis and beri beri were common and destructive maladies. The dysenteries and tropical diseases of the liver met with were made the object of especial study, and one of the most important results of the expedition was the isolation by Dr. Flexner, from the dejecta of patients, of a bacillus which is almost certainly the cause of the acute dysentery studied. The causative agent in this disease once known, it is perhaps not too much to hope that a preventive inoculation may be devised which will render individuals going to the islands immune from attack. Such a prophylactic measure if invented would be of incalculable value, since, according to an authoritative text book, "In the tropics dysentery destroys more lives than cholera, and it has been more fatal to armies than powder and shot." Malarial fevers are frequently encountered, and in Manila the parasites of the tertian and of the æstivo-autumnal variety are easily demonstrable in the blood of patients suffering from these types of the infection. The frequency and malignancy of the cases vary with the locality and with the season of the year. The deadly *calentura perniciosa* is much feared in certain districts, and as soon as the country is settled this form of malaria should be thoroughly studied. The forests of the interior of Mindoro and the regions adjacent to the Rio Agusan in Mindanao are localities of unusual interest in this connection. The relation of mosquitoes to malaria, so vital a question at the moment, is one well worthy of attack in the Malayan archipelago. Not uninteresting too, in passing, is the statement in certain of the Jesuitical records of Mindanao that the natives of that island recognized as far back as two centuries ago a relation between the intermittent fevers and the prevalence of mosquitoes.

At Cavite, an outbreak of some two hundred cases of beri beri among the Filipino prisoners yielded wide opportunity for the study of this disease in its various clinical and pathological aspects. In the same town a large epidemic of what was probably Dengue fever occurred.

The cases at the Spanish hospital of San Juan de Dios, those at San Lazarus, the leprosy hospital, and those at the city asylum, were made accessible to study through the kindness of Major Frank Bourns, of the Provost-Marshall's department. There were still a few smallpox cases in the city, though through the strenuous exertions of the officer mentioned, in the way of compulsory vaccination and the establishment of a *carabao* vaccine farm, this disease, which claimed so many victims from among the American soldiers at the beginning of the occupation, was practically stamped out of Manila. Skin diseases are very prevalent among the natives, and the affection known as dhobie itch (for the most part a form of ringworm) attacked large numbers of American soldiers.

A considerable amount of pathological material was collected by the members of the Commission especially from cases of beri beri, leprosy and dysentery, and this was brought back to America for further study. An abundance of plague material was similarly collected at Hong Kong. Bubonic plague does not exist in Manila, and a careful search through the older records would make it appear that it has never broken out in the Philippines.

The climate, though trying, owing to the continuous heat and moisture, is believed to be supportable if Americans will take certain necessary precautions. As one genial Englishman who has lived in Manila nineteen years, and who is now in perfect health, put it, "it is not so much the climate as the glass bottle which injures people out here." The visit of the Commission to the islands was made in the hottest season of the year, and at the beginning of July the onset of the rains by increasing the moisture in the air added much to the discomfort. However, if one carefully chooses his diet, eschewsiced drinks, clothes himself rationally, avoids excesses both physical and mental, keeps out of the sun during the hottest time of the day, sleeps under mosquito-netting and does not bathe in too cold water, he may live a fairly comfortable life and will probably enjoy good health. Indeed, some Americans have found themselves in better health in Manila than at home, though this is the exception rather than the rule. Diarrheal troubles are very frequent and are to be combated by rest, a simple diet and, if necessary, by wearing a woolen abdominal band. Much has been written about the drinking of boiled water by the soldiers. Outside Manila this is certainly desirable, but any attempt to persuade soldiers on the march to follow this custom will probably prove futile. The Johns Hopkins party walked one afternoon from the Baguio river to San Fernando, and before the end of the journey found themselves drinking any water available, some of it certainly far from pure.

Early in July, Mr. Garrett left Manila for a trip through Java, and a few days later the rest of the party returned to Hong Kong, and began the homeward voyage which was made by way of Suez and London. Two members of the commission spent three weeks in India, and there examined as fully as possible in the time, the outbreaks of plague which existed and the plague measures adopted by English officers in the Indian Empire. In Bombay, Colonel Weir, and Poona, Major Reid and Major Windle accompanied them to the scene of the outbreaks.

The excursion to Poona was most impressive. Traveling upward for hours through the Western Ghats, the country was so beautiful and the air so much cooler than at the sea level, that one could scarcely believe that he was approaching, in the plain, a little lower down on the other side, the pest-stricken city of Poona. On arrival at the railway station, however, the first signs of distress were noticed. Train-loads of people were fleeing from the place. A drive through the town to the office of the chief plague authority showed how rapidly it was being deserted. Many of the streets were almost empty, shop doors and windows were closed and barricaded, plague notices were pasted on the wall, a preternatural stillness was everywhere noticeable, the few people encountered walking quietly along with heads bowed and faces sorrowful. A visit was made to some houses whence plague cases had just been reported with the native editor of the principal Poona newspaper, this gentleman having volunteered his services as plague inspector. In a small hovel, scarcely larger than a ship's cabin, one might find a patient surrounded by several of his friends awaiting the arrival of the inspector. The chances for contact contamination were manifold.

At the general plague hospital, there were some eight hundred cases of the disease under the charge of Major Windle. He was assisted by eight European nurses and a number of native helpers. He complained that it was almost impossible to retain natives as workmen; even washermen and grave-diggers could not be employed in sufficient numbers owing to the fears and prejudices of the people. Cartloads of the newly attacked were being brought into the hospital at its entrance, while a body was carried out from the wards every ten minutes to the morgue at the rear. Those who live in the West can scarcely appreciate the enormous disadvantages under which medical men fight plague in India. The people are ignorant and superstitious, the rigid caste rules prevent any successful application of modern hygienic measures, and even the preventive inoculation cannot be utilized to any great extent, owing to the fact that thus far the bacilli have been grown in beef-broth, and the natives will not countenance such a profanation of the sacred animal. Even in death, caste rules have to be observed, and it was found at the morgue that partitions had to be put up separating the low-caste Hindoos from those of high caste, from the Mohammedans and from the Parsees and Christians. The floor of the morgue presented a melancholy sight; in one of the rooms no less than thirty-two bodies lay upon the ground as closely packed as was possible without actually piling the bodies upon one another. Mohammedans are buried, and high-caste Hindoos are burned, but the bodies sometimes accumulate so fast that they cannot be disposed of by the usual methods. Major Windle stated that one day, a short time before, he had burned twenty-four bodies in one heap. It is absolutely impossible in Poona to employ occidental methods in the way of segregation or disinfection. The natives prefer to die rather than submit to rules which are obnoxious to them. It is no uncommon sight to see a widow, after uttering the death wail, beating her face and breasts and throwing herself violently upon the body of her dead husband, kissing his face and lips; it is very strange that no more than do contract the disease. One left Poona and

Bombay thankful that in America no such unfavorable religious and social conditions prevail.

Of the results which have been obtained by the Commission, it is too early as yet to speak more than generally. The observations made in Manila have to be supplemented and controlled by further microscopical and bacteriological studies upon the material collected. It will be some months at least before a full report can be looked for.

At present the observations concerning the causation of dysentery, the differentiation of the fevers of the region, the relative prevalence of typhoid fever and malaria, the studies of the varieties of the malarial parasite there found, and the investigations of beri beri, may be specified as among the more important scientific results of the expedition. The influence of the scientific spirit and methods, with the demonstration of their practical utility, so beneficial in medical centres at home and exerted at so early a period in the American régime in the Philippines, can scarcely fail to be of significance in the further development of medicine there.

It is probable that in the near future other expeditions will be undertaken as only a beginning in the study of tropical medicine has been made. England and Germany are alive to

the importance of such investigations. Major Ross has recently been sent to East Africa to continue his studies upon the part played by mosquitoes in the dissemination of malarial parasites, and Dr. Wright is being sent by the English government to establish a laboratory in the Malay peninsula for the study of beri beri. Prof. Koch, of Berlin, has also lately been sent on another expedition for the investigation of the malarial fevers in the tropics. Schools of tropical medicine are being established at various English and continental ports. The time seems ripe also for undertaking instruction in tropical diseases in America. The establishment of investigating institutes, and of teaching departments in such cities as San Francisco, New Orleans, Baltimore and New York, would be an additional safeguard to the country, since these are ports most likely to be infected. Moreover, careful instruction as regards diseases peculiar to the tropics and the special character assumed by other diseases when they occur in the hotter regions of the earth would seem to be essentials for those American physicians and surgeons who contemplate residence or practice in our tropical possessions.

LEWELLYS F. BARKER.

AN APPARATUS TO AID THE INTRODUCTION OF A CATHETER OR BOUGIE.

BY GEORGE WALKER, M. D., *Chief of Clinic out-door Surgical Department, Johns Hopkins Hospital.*

The accompanying cut is an apparatus which I have devised to facilitate the passage of a filiform bougie, or catheter, through a strictured urethra. The object of this instrument, is to distend the canal, and in this way to enlarge the narrowed portion, so that an instrument will pass through.

Fig. I (*a*) is a glass cylinder, the shape and size as seen in the cut, with three openings; the first (*b*) is to communicate with the urethra; the second (*c*) permits the entrance of oil from cylinder (*m*), Fig. III; the third (*d*) is for the reception of a rubber stopper carrying a catheter, or bougie; (*f*) is a pure rubber stopper, through the center of which is passed a glass tube (*g*); on the inner end of this is fitted a small ring of rubber tubing (*n*). Through this glass tube a catheter (*e*) is passed, and the rubber on the end is so fitted that it serves to prevent an outward flow of oil.

Fig. II is a rubber stopper similar to the above, with a very small opening through it, just large enough to admit easily the passage of a filiform bougie (*l*) and small enough to prevent the escape of oil or other fluid.

Fig. III (*m*) is a cylindrical glass vessel for the reception of oil; it is to be hung on wall and is connected with Fig. I, by a rubber tube (*i*) of varying lengths.

A rather stiff silk catheter should be used, as a soft-rubber one has a tendency to bend in the glass cylinder. The free end of the catheter is closed with a clamp or hard-rubber stopper, so as to prevent the escape of oil.

When required for use the cylinder (*d*) is filled with oil by slightly opening the pinch-cock (*h*); the end (*b*) is then introduced into the meatus and firmly held there by an assistant so as to prevent the escape of oil between the glass and

urethra. The catheter, or bougie, is then passed into the urethra as far as the strictured part; the stop-cock (*h*) is now



Fig. III.

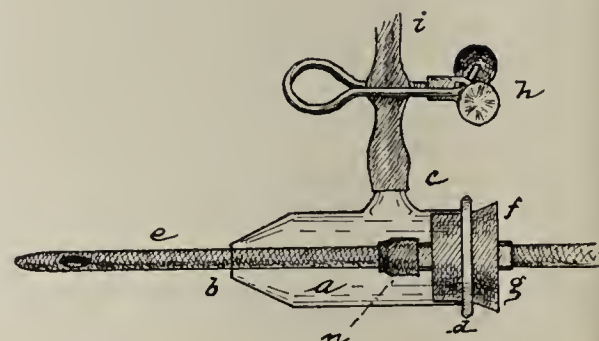


Fig. I.

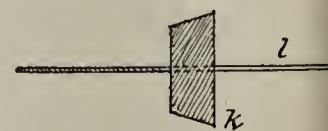


Fig. II.

opened, and the oil allowed to flow in and distend the urethra. As this is being done the catheter, or bougie, is firmly pushed

inward, and as the walls are distended the stricture is slightly opened, and the instrument allowed to slip through.

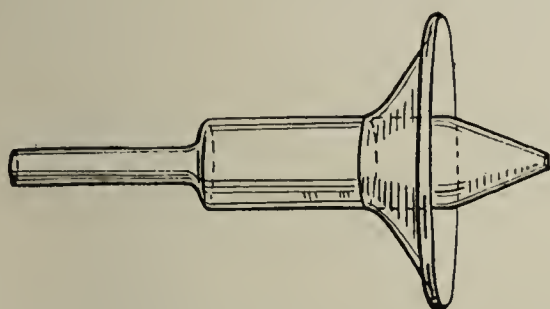


FIG. IV.—An Improved Urethral Irrigating Nozzle.

I do not say that by its use all urethræ can be made permeable, but certainly filiforms can be thus introduced in a num-

ber of cases which without it would be impossible, and catheters passed through diseased portions that otherwise would admit only filiform. Thanks are due Dr. Andrew Stewart, of Washington, for some suggestions.

Fig. IV represents an irrigating nozzle showing an addition to the ordinary straight nozzle in the form of a disc-shaped flange attached to the body near the urethral end. The disc serves to protect one's hands and other objects in the vicinity from becoming soiled by the fluids which are ejected from the meatus during irrigation. The straight nozzle which I have used resembles in some particulars those of Valentine and Young. The complete nozzle is made in one piece; it is simple, cleanly, small and entirely efficacious.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

J. WHITRIDGE WILLIAMS, M. D. The Frequency of Contracted Pelves in the First Thousand Women Delivered in the Obstetrical Department of the Johns Hopkins Hospital.—*Obstetrics*, Vol. I, Nos. 5 and 6, 1899.

1. In our material, the frequency of contracted pelvis (13.1 per cent.) corresponds very closely with the general average of frequency observed in Germany.

2. This is due, in large part, to the presence of a large black population in Baltimore, 469 out of our 1,000 cases being colored women.

3. Contracted pelvis are 2.77 times more frequent in black than in white women, and occur in 19.83 per cent. of the former and 7.14 per cent. of the latter.

4. The statistics of Reynolds Crossen and myself indicate that contracted pelvis are observed in about 7 per cent. of the white women of this country, or about once in every fourteenth case.

5. Contracted pelvis, accordingly, occur in our white women about as frequently as in many German clinics, notably, Rostock, Breslau and Basel.

6. And occur quite as frequently as in Paris (Pinard and Budin) and more frequently than in Vienna.

7. As every fourteenth white and every fifth colored woman possesses a contracted pelvis, the necessity for routine pelvimetry becomes apparent.

J. WHITRIDGE WILLIAMS, M. D. A Case of Spondylolisthesis, with Description of the Pelvis.—*American Journal of Obstetrics*, Vol. XL, pp. 145-171; also, *Transactions of the American Gynecological Society*, Vol. XXIV, pp. 49-79.

In this article is described the pelvis obtained from a woman lying after a symphyseotomy performed on account of a pelvis contracted by spondylolisthesis. The smallest antero-posterior diameter of the pelvis, extending from the lower margin of the third lumbar vertebra, to the upper and posterior margin of the symphysis pubis, was 6½ cm.

The article is accompanied by numerous illustrations, which clearly illustrate the deformity, as well as its mode of production. This is the first American case which has been described anatomically, though such cases have been observed clinically by Blake, Lombard, Flint, Gibney and Lovett.

A full list of the literature on the subject accompanies the article.

J. WHITRIDGE WILLIAMS, M. D. Report of the Committee of the American Gynecological Society, of which Dr. Williams was Chairman, "On the Value of Antistreptococcic Serum in the Treatment of Puerperal Infection."—*American Journal of Obstetrics*, Vol. XL, pp. 289-314; and *Transactions of the American Gynecological Society*, Vol. XXIV, pp. 80-110.

I. A study of the literature shows that 352 cases of puerperal infection have been treated by many observers, with a mortality of 20.74 per cent.; where streptococci were positively demonstrated the mortality was 33 per cent.

II. Marmorek's claim that his antistreptococcic serum will cure streptococcic puerperal infection, does not appear to be substantiated by the results thus far reported.

III. Experimental work has cast grave doubts upon the efficiency of antistreptococcic serum in clinical work, by showing that a serum which is obtained from a given streptococcus may protect an animal from that organism, but may be absolutely inefficient against another streptococcus, and that the number of serums which may be prepared is limited only by the number of varieties of streptococci which may exist.

IV. Thus far the only definite result of Marmorek's work is the development of a method by which we can increase the virulence of certain streptococci to an almost inconceivable extent, so that one hundred-billionth of a cubic centimeter of a culture will kill a rabbit.

V. The personal experience of your committee has shown that the mortality of streptococcus endometritis, if not interfered with, is something less than 5 per cent., and that such cases tend to recover if Nature's work is not undone by too energetic local treatment.

VI. We unhesitatingly condemn curettage and total hysterectomy in streptococcus infections after a full-term delivery, and attribute a large part of the excessive mortality in the literature to the former operation.

VII. In puerperal infections a portion of the uterine lochia should be removed by Döderlein's tube for bacteriological examination, and an intra-uterine douche of four to five liters of sterile salt solution given just afterward. If the infection be due to streptococci, the uterus should not be touched again, and the patient be given very large doses of strychnia and alcohol, if necessary. If the infection be due to other organisms, repeated douchings and even curettage may be advisable.

VIII. If the infection extends toward the peritoneal cavity,

and in gravely septicemic cases, Pryor's method of isolating the uterus by packing the pelvis with iodoform gauze may be of service.

IX. The experience of one of the members of the committee with antistreptococcus serum has shown that it has no deleterious effect upon the patient, and therefore may be tried if desired. But we find nothing in the clinical or experimental literature or in our own experience, to indicate that its employment will materially improve the general results in the treatment of streptococcus puerperal infection.

HOWARD A. KELLY, M. D. A Curette for Cervical Cancer.—*American Journal of Obstetrics*, Vol. XL, 1899, p. 829.

The author has devised a toothed curette for the removal of redundant carcinomatous material in cases of cancer of the

cervix, which he considers much more satisfactory than any of the dull or sharp scoops now in use.

The instrument consists of a stout handle $9\frac{1}{2}$ cm. long, a shank $11\frac{1}{2}$ cm., tapering to an ovoid bowl which is 4 cm. long, 17 mm. wide, and 14 mm. deep. The essential feature of the curette is the series of crenations, each 2 mm. in height and $2\frac{1}{2}$ mm. wide at the base, surmounting its blunt margin. These little teeth are very effective in removing the diseased tissue. A smaller instrument, two-thirds the size of the one described, is also used.

W. H. WELCH, M. D. Thrombosis and Embolism.—*Albutt's System of Medicine*, Vol. VII, 1899.

—The Material Needs of Medical Education.—*Journal of the Alumni Association of the College of Physicians and Surgeons*, Vol. II, No. 4, 1900.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Tuesday, December 5, 1899.

Exhibition of Surgical Cases.—DR. MITCHELL.

We have to show three cases that have been treated in the service of Dr. Halsted, during the last few months, all traumatic and all having been serious accidents.

CASE I.—The first man, a miner, aged 28 years, was admitted in August with the history of an injury received 32 hours previously, having been crushed under a mass of falling coal. He was unable to walk after the accident on account of pain, though he had perfect motion of the limbs and could stand. He had retention of urine and was catheterized by a physician at the mines and the bladder was later aspirated. The urine obtained by catheterization contained a great deal of blood, but the aspirated secretion was clear. He was operated upon immediately after his entrance to the hospital.

On examination, the patient was unable to stand, the bladder was much distended, reaching almost to the umbilicus; the perineum was infiltrated with blood. A perineal incision was made, opening a cavity beneath the symphysis pubis, which was filled with blood clots and urine; the bladder still remained distended. A catheter passed through the meatus entered this cavity in the perineum, thus locating one end of the ruptured urethra. Suprapubic cystotomy was then done and retrograde catheterization showed the proximal end of the urethra, which had been ruptured just beneath the symphysis pubis. The urine in the bladder was perfectly clear. There was a fracture of the ascending and descending ramus of the left pubic bone, and a separation of the symphysis pubis. By attaching a piece of silk to a soft-rubber catheter, we were able to pass it through the entire course of the urethra. The urethra was not sutured because of the wide separation. A Bloodgood suprapubic tube was fixed in the bladder, and the perineal wound packed with gauze. The patient did very well. The bladder could be irrigated through the catheter and there was no trouble from infection. The catheter was allowed to stay in until September, when it was removed because blocked with salts, and a new one introduced. This was finally removed, nearly two months after the

operation, but the urethra still opened in the perineum. On October 23rd, the suprapubic tube was removed and the wound allowed to close, and from that time he has been voiding partly through the meatus and partly from the perineal wound, the latter having closed only within the last few days. The urethra has been dilated from time to time and a number 27 sound can be introduced with ease. He walks without evidence of trouble. The pubis is evidently firmly united.

CASE II.—This is a case of recovery after very great shock. The man was admitted ten days ago, about 6.30 p. m., in very bad condition and with the history of an injury to his right arm a short time before. He was working in a guano factory when his arm was caught in the machinery, and the forearm and hand very badly crushed. The skin of the arm was torn from the shoulder, down just as you would tear out the sleeve of a coat. His pulse was 80 and very weak, respiration 40, temperature 97.5° , and he was crying with pain and begging to have the arm taken off. He was immediately put to bed, the arm dressed with sterile gauze, the foot of the bed elevated and he was infused with 600 cc. of salt solution in the breast, and given $\frac{1}{2}$ gr. morphia and a hot enema of coffee and salt solution. Up to 10 o'clock he improved, his pulse had become much stronger, he was quiet, his respiration slower and altogether he seemed better. After that time he began to go down again rapidly and there was considerable oozing from the dressings. He was in very bad condition when put on the table at 11 p. m., and though he was under ether only 10 minutes his condition became much worse during that time. He was given strychnia hypodermically and salt solution infusion during the operation. The foot of the table was elevated and his legs tightly bandaged. The operation itself lasted only 5 minutes. Dr. Bloodgood controlled the vessels by digital pressure in the axilla and the arm was amputated just below the shoulder. The vessels were quickly tied and the wound packed with gauze. At the end of this brief period, however, the radial pulse could not be felt, and the heart-sounds were so weak that the second sound could not be heard after the operation. The foot of his bed was kept elevated, he was infused again with salt solution and given

hypodermics of strychnia and morphia with hot enemata of coffee and salt solution. His condition remained very alarming during all that night, the pulse being rapid and weak, the temperature rising to 103.6° and he became delirious, attempting to bite and scratch the assistants. Towards morning, however, he became quiet and from that time on has made a rapid convalescence. The wound was inspected a few days after the operation and everything was found clean and in good shape. His blood-count has been somewhat interesting. The night of the operation it was practically normal, although there had been a great deal of hemorrhage—red corpuscles 5,000,000, leucocytes 23,000, and hemoglobin 70 per cent. Thirty-six hours later it showed reds 3,000,000, leucocytes 12,000 and hemoglobin 50 per cent.

CASE III. This case has been very interesting to us in connection with the question of nerve regeneration. He is a German, 38 years of age, and was admitted on the 10th of November with an injury of the inner and posterior part of the left arm, having been in contact with a buzz-saw. He was admitted in fairly good condition and kept quiet for two hours before operation, when he was put on the table and the arm cleaned very thoroughly. No anesthetic was used and although the operation lasted two hours or more, no bad effect was produced so far as we could see. There were three main cuts with numerous lacerations extending from them. The upper cut exposed the musculospiral and ulnar nerves and divided the internal cutaneous. The second cut divided the ulnar, made a large opening into the bone and divided the musculospiral just where it winds around the bone, while the third cut divided the median nerve just above the elbow, without exposing the artery. The triceps muscle was extensively lacerated and the ulnar nerve was hanging in this mass of lacerated muscle which was torn entirely from the bone at one point. The biceps was also partially divided and there was extensive laceration of the skin. We identified the peripheral portion of the nerves by pinching the ends slightly and getting a corresponding contraction. The central portions could be identified by pain when they were seized. A hasty examination for anesthesia was made and it was thought to be complete, but since then we find that we were mistaken. The nerves were sutured, the muscles brought together with buried silver and catgut sutures, and the skin approximated loosely over the wound. The man has made a perfect recovery and everything has healed per primam except the portions where there was no skin and these are covered by healthy blood clot. At the first dressing we found complete anesthesia of those portions supplied by the median, ulnar and musculospiral nerves. The only sensitive area was that supplied by the external cutaneous and some filaments of the musculospiral that came off above the injury.

DISCUSSION.

DR. THOMAS.—Was there any difficulty in bringing the ends of the nerves together?

DR. MITCHELL.—They were very far apart at the time, but we had no difficulty in approximating them and suturing without tension.

DR. THOMAS.—It will be very interesting to watch his recovery and note where regeneration first takes place, since all the nerves were completely divided.

AN IMPROVED STETHOSCOPE. DR. CABOT.—I have with me a stethoscope that I have used on about 40 cases a day for five months and which pleases me so much that I thought it worth while to bring it before you. It was invented by a gentleman in Boston, not a physician, who had seen the ordinary stethoscope and who thought he could make an instrument that would combine the advantages of this with those of the phonendoscope. It consists of a simple diaphragm of metal like that of the telephone connected with the chamber into which the tube of the stethoscope enters. It magnifies all sounds and it might be said to bear the same relation to the ordinary stethoscope that the high power of the microscope does to the low power. With it you can, I think, also hear sounds deeper in the chest than those heard with any other stethoscope. I have used it constantly for examination of the lungs and heart and find it exceedingly valuable for both. It enables you to hear cardiac murmurs, especially those of aortic regurgitation that can not be heard in any other way and this seems to me to be a point of great importance. The murmurs of mitral stenosis are not always, however, heard as well as with the ordinary stethoscope; that fact I can not account for.

A very obvious advantage of the instrument is that in listening to cases of pneumonia of the posterior lobes where the patient is very weak and you do not want to turn him, you can slip this flat edge under the back and hear the sounds with ease. I have known of an instance of a consultant being called from New York to Boston in such a case and feeling that he had not the right to turn the patient or raise him no examination of the lungs was made for two days. With such instrument as this such a delay could not occur.

I think also it is not an exaggeration to say that you can hear as much of the heart-sounds through the clothes with this instrument as you can with any other instrument next the skin. You should not listen to the lungs through the clothes, because the friction sounds of the clothes are so much like those of the lungs.

There are certain things that you can not do with it. If the patient has a very thin bony chest you do not get good effects, and it is not always good for very superficial sounds. I always carry the bell of the ordinary stethoscope to slip on for such cases. I don't think I should want the instrument alone without this arrangement, but I certainly should not want ever to be without this instrument again. I feel sure that any one who ever tries it will not give it up until something better is invented.

THE PULMONIC SECOND SOUND. DR. CABOT.—About one year ago, in reading Gibson's recent work on the heart, I noticed some observations concerning the second sound in health that disturbed me a great deal. I had always been taught that in health the pulmonary second sound was not so loud as the corresponding sound from the other side. Dr. Sarah R. Creighton went over one thousand cases

this summer in my clinic with reference to this point, throwing out all cases where there was anything wrong with the heart. She showed that in each decade, there is a rising percentage of aortic and a diminishing percentage of pulmonic accentuation as compared with the preceding decade. In other words, unless these one thousand cases are very deceptive, the accentuation of the aortic sound is a matter of age, the pulmonic sound being louder in the young and the aortic in older persons.

One other point that has struck me in the last two years in the examination of the normal chest is the presence in healthy persons of fine râles at the base of each axilla. If you listen in persons over 40 years of age, you will hear in a large proportion of cases these fine crepitant râles at the end of inspiration. They are heard over a very small area, frequently not larger than half the size of your palm. The explanation of this phenomenon is entirely dark to me. I thought it might be due to the formation of pleural adhesions, but I find it in connection with Litten's phenomenon so frequently that I can not see how that explanation can be accepted, so that I leave the observation as a purely clinical one without explanation.

BOOKS RECEIVED.

Transactions of the American Surgical Association. Volume the seventeenth. Edited by De Forest Willard, A. M., M. D., Ph. D. 1899. 8vo. XLII+319 pages. Printed for the Association, Philadelphia.

Transactions of the American Orthopedic Association. Thirteenth session, held at New York, N. Y., May 31 and June 1 and 2, 1899. Volume XII. 8vo. XXVIII+367 pages. 1899. Published by the Association, Philadelphia.

King's College Hospital Reports; being the annual report of King's College Hospital and the medical department of King's College. Edited by Nestor Tirard, M. D., F. R. C. P., et al. Volume V. (Oct. 1st, 1897-Sept. 30th, 1898). 1899. 8vo. XVII+270 pages. Printed by Adlard and Son, London.

An Experimental Research into Surgical Shock. An Essay awarded the Cartwright Prize for 1897. By George W. Crile, A. M., M. D., Ph. D. 1899. 8vo. 160 pages. J. B. Lippincott Co., Philadelphia.

The Serum Diagnosis of Disease. By Richard C. Cabot, M. D. 1899. 8vo. VII+154 pages. William Wood and Company, New York.

The Principles of Bacteriology. A practical manual for students and physicians. By A. C. Abbott, M. D. Fifth edition, enlarged and thoroughly revised. With 109 illustrations, of which 26 are colored. 1899. 12mo. XI+590 pages. Lea Brothers and Co., Philadelphia and New York.

A Text-Book of Pharmacology and Therapeutics, or the Action of Drugs in Health and Disease. By Arthur R. Cushny, M. A., M. D., Aberd. Illustrated with forty-seven engravings. 1899. 8vo. 730 pages. Lea Brothers and Co., Philadelphia and New York.

A Practical Treatise on Fractures and Dislocations. By Lewis A. Stimson, B. A., M. D. With 326 illustrations and 20 plates in monotint. 1899. 8vo. XIX+822 pages. Lea Brothers and Co., New York and Philadelphia.

Transactions of the American Gynecological Society. Volume XXIV. 1899. 8vo. XLVII+520 pages. Wm. J. Dornan, Printer, Phila.

Transactions of the Indiana State Medical Society, 1899. Fiftieth annual session held in Indianapolis, Indiana, June first and second, 1899. 8vo. 552 pages. Central Printing Company, Indianapolis, Indiana.

Thirtieth Annual Report of the State Board of Health of Massachusetts, 1898. 8vo. XXXIX+878 pages. 1899. Wright and Potter Printing Company, Boston.

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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

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REPORT UPON AN EXPEDITION SENT BY THE JOHNS HOPKINS UNIVERSITY TO INVESTIGATE THE PREVALENT DISEASES IN THE PHILIPPINES.

TO PRESIDENT GILMAN, DOCTORS WELCH AND OSLER,
Philippine Committee of the Johns Hopkins University Medical School.

Gentlemen:—We have the honor to submit to you a brief account of our work and movements in carrying out your commission to study the prevalent diseases in the Philippine Archipelago. Your commissioners, consisting of Dr. Simon Flexner and Dr. L. F. Barker, to whom were voluntarily attached Messrs. J. M. Flint and F. P. Gay, of the Medical School, the latter having given their time and paid all their own expenses, sailed from Vancouver on March 29th, 1899, and arrived in Manila, May 4th, where they immediately established themselves for the purpose of the work mentioned. Owing to the military situation it was found impracticable to visit other ports in the Archipelago or to penetrate into the interior of the island of Luzon. The entire time of the commission, therefore, was spent in the study of disease existing among the natives and American troops in Manila and at Cavite.

WORK IN JAPAN AND HONG-KONG.

As transport sailings were uncertain, and the passage out by them slow, it was decided to save time and go by fast steamer, the Canadian Pacific Railway giving special rates to the commission on tickets around the world.

The original plan of your commissioners was to proceed directly to Manila by way of Hong-Kong, at which latter port

it was intended to stop only long enough to outfit for the tropics and to catch the earliest steamer sailing for Manila. After consideration of the probability that certain new kinds or phases of disease, not occurring in temperate regions, might be encountered in the Archipelago, and of the fact that the diseases of the Philippines would probably have much in common with those of Japan, it was decided to spend one week in Japan, where modern hospitals could be visited and advantage taken of the results of the study of tropical disease by highly trained and eminent Japanese physicians. The decision proved to be valuable in many ways; and we especially desire to express our obligations to Professors Aoyama, Mitsukuri, Miura and Kitasato, who showed us many courtesies. The opportunity to see in the Japanese hospitals pure and mixed examples of beri-beri assisted us greatly in our subsequent studies, as did also the observations on dysentery made in the Institute for Infectious Diseases at Tokio.

While outfitting at Hong-Kong we improved the opportunity to study the bubonic plague, which was still prevailing at that port. This study was made easy by the generosity and courtesy of the English Civil Physician, Dr. James Lowson, in charge of the Plague Hospital and Mortuary. The study, begun in this way, was extended when two months later we returned to Hong-Kong, *en route* to America. At this time a considerable exacerbation of the disease had taken place, and within a week or ten days we saw several scores of cases and performed many

autopsies. The several forms of infection: inguinal, axillary, tonsillar, cervical and pulmonary, were thus encountered. Bacteriological examinations were made and tissues collected for future study. Two of the party (Dr. Barker and Mr. Flint) spent on the return journey three weeks (at their own expense) in India, where the great epidemics of plague there raging were observed.

ARRIVAL IN MANILA.

Immediately upon our arrival in Manila, quarters were sought at the "Hotel de Oriente." Very insufficient accommodations were secured for a limited time, as the sudden accession of families of Army and Naval officers had strained the hotel to its fullest capacity. Having been forewarned of the conditions of living in Manila, we took the precaution to bring with us from Hong-Kong a group of Chinese servants, intending to set up housekeeping if practicable. After much difficulty a small house was secured in San Miguel, where, by hiring parts of the furnishings and buying what could not be rented, a temporary establishment was secured.

Within a few hours after our arrival, the credentials and private letters brought were presented to Colonel Woodhull, Surgeon-in-Chief to the 8th Army Corps, and to General Otis. Colonel Woodhull afforded us every opportunity to prosecute our work in the military hospitals. Although no special introduction was in our possession, we quickly met Dr. Bournes, chief health officer of Manila, who opened to us the hospitals under his charge. Somewhat later we met Dr. Pearson, Chief Naval Surgeon, who opened to us the Naval Hospital at Cavite.

HOSPITALS IN MANILA.

Civil Hospitals. These consist of a large hospital within the walled city, *San Juan de Dios*. It has a capacity of from 250 to 300 beds, and accommodated, during our stay, both natives and Europeans. The number of European patients was small. When the military hospitals were much crowded a certain number of wounded prisoners of war were accommodated. The hospital contained chiefly native medical cases of both sexes. The *San Lazaro* or leper hospital, in the outskirts of Manila, contained from 80 to 100 lepers during our stay. These had come from Luzon, almost exclusively from Manila and its immediate surroundings. The two sexes are provided for in separate, large and airy wards. One wing of the building, having a private entrance, is devoted to native prostitutes who apply regularly for examination, and are incarcerated here and treated medically when found to be suffering from venereal disease.

Military Hospitals. These consisted, besides the regimental hospitals which were virtually detention camps, of three Reserve Hospitals—the 1st, 2nd and 3rd Reserve Hospitals; a convalescent hospital on Corregidor Island and the Hospital Ship *Relief*, which was anchored in the bay. The First Reserve Hospital, under the control of Major Crosby, had been originally the Spanish military hospital. It has been from time to time, by the erection of tents over platforms raised a foot or two from the ground, increased in capacity until in July it contained 1200 or more beds. The Second Reserve Hospital, under the control of Major Keefer, was a transformed

modern school-building, and because of its limited capacity (250 beds), high ceilings and wide corridors it made a model hospital. The Third Reserve Hospital had just been established towards the end of our visit, and was smaller than the others and intended as a convalescent hospital. The hospital at Corregidor is a temporary structure and intended for convalescents. It is especially well adapted for its purpose because of the high and hilly character of the island and its complete investment by the sea. The *Relief* was used as a hospital for acute cases; but some time before we left, the acute cases were transferred to the Reserve Hospitals, and the *Relief* sailed for San Francisco with invalided men.

The Reserve Hospitals accommodated especially American sick and wounded; but a ward in the First Reserve Hospital was set aside for the Filipino wounded.

After the outbreak of beri-beri at Cavite, a hospital under military control was established at San Roque in the remains of the Spanish Marine Hospital which had been wrecked by the insurgents.

Naval Hospital. A small hospital for sick seamen and marines was established at Cavite. Through the courtesy of Dr. Pearson this was open to us for clinical studies.

Clinical, Pathological and Bacteriological Laboratory. Through the kindness of Colonel Woodhull and of Major Crosby, the officer-in-chief of the First Reserve Hospital, a small Filipino house, situated on the banks of the Pasig, was given us in which to establish a laboratory. This was done on the second floor of the house. The expense of putting up worktables was kindly borne by the Medical Corps of the Army. The laboratory equipment was set up in this building, and within a very few days after our arrival work was begun. We desire to speak of the co-operation of the Medical Staff of the hospital who afforded us every opportunity to visit the wards, and many of whom joined or assisted us in clinical and pathological work. We wish especially to acknowledge the co-operation and assistance of Lieut. Richard P. Strong, a graduate of the Johns Hopkins University Medical School, who had on our arrival already begun to do laboratory work and who gave up much of his valuable time in furthering our interests. It was found unnecessary to establish laboratories in the other hospitals, in the first place, because all were connected with the First Reserve by the Signal Service telegraphic system of which we had free use; and next, because all the dead were carried to the morgue in conjunction with the First Reserve Hospital. We went or were frequently called to the other hospitals to make clinical and bacteriological examinations.

With few exceptions, all the dead were subject to autopsy. Post-mortem examinations were made at the Civil Hospitals upon natives, and at the Military Hospital upon all that died. Exceptions were made only in the cases of those dead from gun-shot wounds, when, if pressed for time, necropsies were sometimes omitted.

PREVAILING DISEASES.

The subject of the prevalent diseases may be considered as they affect (1) the natives, and (2) Europeans and Americans especially the American garrison.

Diseases affecting Natives. (a) *Skin Diseases.* Of the skin diseases prevailing among the natives, aside from small-pox and other specific exanthemata, may be mentioned (1) diseases of the scalp, which are very frequent; (2) dhobie itch; and (3) an affection which resembles closely, and which is probably identical with, Aleppo boil (Delhi boil, Biskra button, *epidemische Beulenkrankheit*). (b) *Small-pox.* This disease has been so generally prevalent in Luzon that the natives have, to a large extent, lost fear of it. All evidence points to the greatest carelessness in preventing its spread during Spanish times. Isolation of the sick and disinfection of the habitations seem not to have been attempted; and vaccination, even among the Spanish garrison, had not been carried out. Under these circumstances it could be no surprise that after the American occupation the disease should appear and even become epidemic. The epidemic which appeared early last year was promptly met by Dr. Bourne, who caused the Spanish garrison still in Manila, and natives and Chinese within the city to be vaccinated. In order to insure satisfactory results he found it necessary to re-establish a vaccine farm in which young *carabao* were used for the preparation of the virus. Under the influence of this measure and by the aid of isolation of the sick, the disease had, in May, practically disappeared within the military lines about Manila. (c) *Leprosy.* A definite focus of this disease exists in Luzon. The cases, in the neighborhood of 100, which are confined in the San Lazaro Hospital, came from Manila and the country immediately surrounding that city. The disease affected both sexes, being more frequent in adults, although also present in half-grown boys and girls. The commonest forms were the tubercular and mutilating. Autopsies were performed upon several cases that had died during our stay. (d) *Tuberculosis.* Accurate statistics of the extent of the prevalence of this disease are difficult if not impossible to obtain. That the disease is a common one is indicated by several facts. It is frequently met with in the native hospitals, where it may have been recognized during life or is disclosed at autopsy. Many cases of supposed beriberi which we autopsied at San Juan de Dios proved to be tuberculosis. It is possible that the two diseases had co-existed, for we found such combinations freely recognized by Japanese physicians in the hospitals in Japan. Tuberculosis of the lungs was also found as a common complication in leprosy individuals that came to autopsy. Not very infrequent spectacles met with on the streets are much emaciated and weak natives affected with suggestive coughs and free expectoration. While it is not certain that these individuals were examples of tuberculosis, there is strong probability that this explanation of their condition is the correct one. (e) *Venereal Diseases.* Syphilis, by general agreement (statistics not available), does not prevail unduly. Chancroids and gonorrhœa are, on the other hand, very common. The majority of the prostitutes confined in the San Lazaro were victims of these two diseases. A very common complication of the soft sore, owing to lack of cleanliness, is swelling and suppuration of the inguinal glands. (f) *Beri-Beri.* This disease is well known among the natives. It would appear to be epidemic and endemic in Luzon. It is, judging from cases met with in San Juan de Dios Hospital and the statements of native phys-

icians, constantly appearing in a sporadic form. During our stay an epidemic appeared among the Filipino prisoners confined at Cavite. Some 200 cases developed in a few weeks; the mortality ranged from 20 to 30 per cent. The several recognized forms of the disease—œdematous, paralytic, and mixed—were encountered. Clinical and bacteriological studies were made upon the living, and the dead were subjected to autopsy and bacteriological examination. The difficulty of getting to and fro between Manila and Cavite, on account of the impossibility of land communication, made this part of our work difficult and time-consuming. A considerable collection of pathological material and other data has been made. This material is now in process of study and arrangement.

Diseases affecting Americans. The chief causes of disability among American land forces are the enteric diseases. These are diarrhœa, dysentery, typhoid fever, and gastro-intestinal catarrhs. Many of the diarrhœas are merely preliminary to the symptoms of dysentery. Other infectious fevers are relatively infrequent. A small number of cases of scarlet fever and diphtheria only were encountered. The malarial fevers prevailed but not seriously during the months of May, June and July. (a) *Dysentery.* This disease is responsible for the greatest amount of invalidation and the highest mortality. It appears in acute, sub-acute, and chronic forms. The chronic form is sometimes attended by secondary abscess of the liver. The acute form may end in 24, 48, or 72 hours. In it the whole of the large intestine and usually the lower portion of the ileum are involved. The mucous membrane of the gut is swollen, congested and œdematous, in places hemorrhages have taken place into the mucous membrane, and the sub-mucosa is swollen and its blood-vessels greatly dilated. No ulcers existed in such cases. Amoebae were absent or very difficult to find in the fresh stools and in the intestinal contents immediately after death. In the sub-acute and chronic forms ulcers are present in the mucosa; the coats of the intestine are greatly thickened; at times large sloughs of mucous membrane, partly detached, occur, and the lesions are confined to the large intestine. Amoebae are more commonly present in these cases, but are variable as to actual occurrence and numbers. Large hepatic abscesses, usually single, were encountered in a number of these cases. Amoebae were variable in the contents of the abscesses. In one very large abscess, occupying both right and left lobes of the liver, no amoebae were seen, but a pure culture of the *Staphylococcus pyogenes citreus* was obtained. The clinical study of the cases of dysentery with reference to amoebae was equally unsatisfactory. In cases with marked symptoms both in patients confined to bed and those beginning to go about but still with persistently loose bowels, these organisms were frequently missed; while in instances ready to be discharged, they might, at certain examinations, be found to be very abundant. In morphology, the amoebae studied corresponded with the amoebae coli found in Egypt and in this country. The bacteriological study of cases of dysentery was carried out upon the fresh stools of acute and chronic cases, and with the intestinal contents, mesenteric glands, liver, etc., of cases dying and subjected to autopsy. The intestinal flora was studied in its entirety by means of plate cultures. Varieties of micro-organisms were separated.

Many of these were well-known species or occurred normally in the situations in which found. Tests with blood sera for agglutination were made, and those organisms giving positive reactions were separated for further study. Two groups of bacilli were thus differentiated: (1) Having affinities with the group of bacillus coli communis. The agglutination was variable, being constant and sensitive with the blood-serum of the same individual (host), and inconstant, and active in relatively strong solutions only, in serums from other individuals. (2) Having affinities with the group of bacilli of which the bacillus typhosus is the type. Agglutination was constant and sensitive with blood-serum of host as well as the sera of other individuals suffering from dysentery. Inactive with normal serum and serum from cases of typhoid fever, malaria and beriberi. A bacillus belonging to the second group, which is still under study, would seem to agree with the bacillus dysenteriae isolated by Shiga from cases of endemic dysentery occurring in Japan. It is regarded by us as an important factor in the causation of the dysentery of the Philippine Islands. Experiments in immunization of animals and the production of vaccine are in progress. (b) *Typhoid Fever*. The total number of cases of typhoid fever in the hospitals during May, June and July was far below that of dysentery; the number of deaths also was less. It was, however, a frequent affection among Americans. The examination of the blood, microscopically and with the Widal test, was of the greatest help in diagnosis. The disease came to autopsy presenting the classical intestinal lesions and also in atypical forms. In the small number of autopsies made upon those dead of this disease, several instances of slight intestinal involvement or even entire escape were met with. These cases would have remained very obscure or even undetermined except for the Widal reaction and bacteriological examination. In some instances the typhoid bacillus was found widely disseminated throughout the body, the autopsy being made immediately after death. (c) *Malarial Fevers*. A large proportion of the cases were sent in from the field and outlying military stations where examinations had to be hastily made, as instances of "malaria" or "intermittent fever" turned out to be cases of other diseases (typhoid fever, dysentery, etc.). A number of true cases of malarial fever were, however, met with, and in the blood of these the characteristic parasites, identical with those occurring in other places in which studies of the blood have been made, were found. No quartan parasites were met with, but cases of quartan affection doubtless exist. Typical infections with the "tertian" and "aestivo-autumnal" varieties of the parasite were encountered by us, and by microscopists among the Army physicians in the Reserve Hospitals and on the *Relief*. One of the fatal cases of malaria was complicated with acute lobar pneumonia. The cases of "calentura perniciosa" which occur in Mindoro, Mindanao and in certain parts of Luzon should be studied as soon as these regions are accessible. The Archipelago is favorable also for the study of the relation of mosquitoes and other insects to malarial infection. Some of the malarial cases were undoubtedly *recidives*, imported from Cuba or elsewhere. A very small number of deaths were referable to malaria. Two instances of acute malarial infection came to us for autopsy.

On the other hand, several instances of malarial pigmentations of the organs, in persons dying from other diseases, were encountered. Parasites in the latter cases were absent. These men had, as a rule, been in Cuba or Porto Rico during the Spanish war.

(d) *Tuberculosis*. A number of cases of pulmonary tuberculosis developed among the soldiers in the American troops. A definite history of exposure to wet and various hardships was elicitable in many of these cases.

(e) *Dengue*. At Cavite there occurred a large outbreak of an epidemic fever of short duration (a few days), known locally as Cavite fever. Almost all who remained in Cavite for any length of time were attacked. Second and third attacks were common. Muscular pains were severe in some cases and not in others. A slight exanthem was present in many of the cases. Flushing of the face, restlessness and general malaise accompanied the fever and rapid heart action. Malarial parasites were not present in the blood, nor did the serum from such cases agglutinate cultures of the typhoid bacillus. The epidemic is regarded as one of Dengue.

(f) *Tropical Ulcers*. A number of the American soldiers suffered from a form of indolent ulceration, locally known as "tropical ulcer." These ulcers occurred singly sometimes, but were more often multiple. They began as small pustules, which gradually extended. They were most frequent among those who had been compelled to make long marches through swampy districts, and the patients themselves attributed the ulceration to "poisoning" in the marshes.

(g) *Wound Infection*. Our experience with wound infections was rather limited. The other problems undertaken, regarded as more important as bearing on the general question of disease and its causation in the Islands, left but little time and opportunity to attack this interesting subject. Certain observations of interest were made. Pyogenic infections due to the common pus cocci occurred. In a small number of gun-shot wounds causing compound fractures emphysematous gangrene occurred and the bacillus aerogenes capsulatus was isolated. In one instance of compound fracture of the tibia, a spore-bearing bacillus was associated with the bacillus aerogenes capsulatus. It was found in cover-slip preparations from the original wound and in the first set of cultures. It could not be further transplanted and hence was not identified. In two other cases was the bacillus aerogenes met with, one a case of peritonitis following infection of the intestine from an incarcerated hernia, and the other also a case of peritonitis but secondary to perforation of a typhoid ulcer of the intestine. The army surgeons were enthusiastic as to the adequacy of the "First-Aid Package" in limiting the number of wound infections.

CLIMATOLOGICAL AND HYGIENIC CONDITIONS.

The climate is that of continual summer. There is a wet season (S. W. Monsoon) and a dry season (N. E. Monsoon). The hottest period is at the end of the dry and the beginning of the wet season—precisely the period of our visit. The climate from November to March is said to be delightful. In the worst season of the year the climate is very trying, and especial precautions are to be taken if Americans are to keep

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FIG. 1.



FIG. 2.



FIG. 2.



FIG. 3.



FIG. 3.

To illustrate Dr. Osler's Case of Multiple Gangrene in Malarial Fever.

well there. The extremes of temperature are not great, but the constancy of the high temperature, together with a high degree of humidity, makes the climate peculiarly enervating. We were interviewed at length while in Manila, officially by the U. S. Philippine Commission, with regard to climate and the hygienic precautions to be observed, as well as with regard to other medical problems in the Islands. The climatic conditions and the hygienic precautions to be taken will form the subject of a fuller report to be made later.

The above represents, briefly stated, the results achieved by your expedition sent to the Philippines. As will be patent to you, not a little yet remains to be done before the scientific portion of the work is completed. This portion of the report is for the present only hinted at or withheld until it shall have been finished. It is the intention of your commissioners to make careful studies of the material relating to beri-beri, dysentery, malarial and typhoid fevers, leprosy, and the bubonic plague, which has been collected. These studies, with the exception of that relating to dysentery, will be carried out upon preserved material, and the labor involved, which has been divided between Baltimore and Philadelphia, will necessitate that some time must elapse before the finished report is forthcoming. The task of completing the study of the bacillus isolated from cases of dysentery has been assigned

to Dr. Flexner, who was principally engaged with that theme during the residence in Manila. In order to carry out the experiments as designed, an outlay for experimental animals and their maintenance will need to be made. It is known to you that the original sum so generously contributed by friends of the University and appropriated for the use of your commission, has been exhausted, and that private means have been drawn upon to defray a part of the expense involved. We would respectfully draw attention to this fact and to the further expenses to be incurred, and request direction as to your wishes regarding these matters.

We wish to express our deep gratitude to Messrs. Flint and Gay, whose untiring efforts during our residence in Manila made it possible to accomplish far more than we could have done unaided. It is a pleasure to acknowledge also many kindnesses on the part of Mr. John W. Garrett.

That we are deeply indebted to the officers in the Medical Service of the U. S. Army and Navy for opportunities and aid, is evident from the report preceding. Courtesies and kindnesses extended by various citizens of Manila, European and native, are here also gratefully acknowledged.

Very respectfully,

SIMON FLEXNER,
LEWELLYS F. BARKER.

A CASE OF MULTIPLE GANGRENE IN MALARIAL FEVER.

(WITH ILLUSTRATIONS.)

BY WILLIAM OSLER, M. D., *Professor of Medicine, Johns Hopkins University.*

There are three groups of cases of multiple gangrene:

(1.) *Raynaud's disease*.—There have been previous well-marked vascular disturbances in the extremities (syncope, asphyxia or hyperæmia), the gangrene is very often symmetrical, is usually slight in extent and limited to the fingers or toes, more rarely to the ear-tips or nose.

(2.) *Multiple spontaneous gangrene of limbs*.—In young or middle-aged persons, without any obvious cause, massive gangrene of one, two or three extremities occurs. Many illustrations of this are recorded in the literature.

(3.) *Multiple spontaneous gangrene in association with the acute infections*.—In measles, typhoid fever, typhus fever, scarlet fever, diphtheria and malaria, local gangrene may occur. There are multiple patches, not symmetrical, and the skin and subjacent tissues are more frequently affected than the extremities. While of course the phenomena of Raynaud's disease may occur as a sequence of any of the specific fevers, a large proportion of all the cases of local gangrene occurring during or after one of the fevers have nothing whatever to do with this affection.

The relationship between malarial fever and Raynaud's disease is believed to be very close. Many references are given to cases (a majority from French sources) by Barlow in his article in Allbutt's System, and more fully by Monroe in his excellent monograph on the disease. (Glasgow, *James Maclehose & Son*, 1899.) Altogether, in the cases he has col-

lected, there were only 8.3 per cent. with malarious antecedents. I have looked over the notes of cases of Raynaud's disease which I have seen in Baltimore, nine in number, and I do not find malaria to be related as an etiological factor in any one of them, nor, so far as I know, in our very large series of cases of malaria during the past ten years has there been a single instance of Raynaud's disease.

The following case is a very remarkable illustration of multiple gangrene occurring in a case of æstivo-autumnal malaria. Similar cases have been reported in the literature, and are referred to by Monroe in his monograph (page 96), but they seem to be exceedingly rare.

CLINICAL SUMMARY.—*Malaria when six years old—typhoid fever twice—last attack four months before onset of present illness—illness in the middle of October, supposed to be influenza, but more probably malaria—on November 2nd, onset of spots of gangrene in various parts—rapid extension—condition on admission as shown in the figures—complexion muddy—spleen enlarged—blood showed very many æstivo-autumnal organisms—temperature slightly elevated at first—subsequently no fever—rapid recovery.*

P. W. B., aged 23, bar-tender, admitted to Ward E, Thursday, November 29, 1899, complaining of sores on various parts of his body.

Family history.—Mother died of consumption. No history of rheumatism or of any special disorders of the skin.

Personal history.—As a child he had measles, mumps and whooping cough. When six years old he had malaria. Five years ago he had a very severe attack of typhoid fever, after which he had an abscess in the abdominal wall, which opened spontaneously and discharged for two months, leaving a large scar. He had at the same time many boils. Last year he went south with the Fifth Regiment, and in August he had a second attack of typhoid fever, and was ill for two months. He has had gonorrhœa twice; has never had lues. He has used tobacco freely; whiskey and beer in moderation.

Present illness.—The patient has been living in Baltimore this autumn, and has been very well until the middle of October, when he was ill in bed for nearly two weeks with pains in the back and general weakness; no fever, no chills, no herpes. The doctor called it influenza. The patient got up and was about for a few days, when, on November 2nd, just twenty-seven days ago, he noticed blebs about half an inch in diameter on both hands, which were slightly swollen. The next day a mottled area appeared on the instep of the left foot. It had a bruised appearance. A similar one appeared on the buttocks and on the dorsum of the right foot. Other spots came in the situation to be subsequently mentioned.

The hands and feet became very much swollen. The blebs broke and discharged a dark fluid; the skin around the affected areas was very red. There was no itching. He had some pain at night. Ten days ago he had slight chilly feelings. There had been no redness, nor swelling, nor blueness of the fingers or toes, and there had been no numbness or tingling. The urine had been clear. Dr. Fletcher made the following note on the day after his admission.

"The patient is a large-framed, well-nourished man; complexion rather sallow. The skin of whole body is pigmented, markedly so about nipple and umbilicus, to slight extent about genitalia; no increase in either axilla. The lips and mucous membranes are of fairly good color; no pigmentation of mucous membranes. Over dorsum of left hand, just behind knuckles, there are four whitish scars, the result of healing vesicles. Over the ring, middle and little fingers there is a brownish-yellow discoloration of the skin which is gradually peeling off where the blebs are healing. On palmar surface of same fingers the skin is raised in large blebs. The skin has a brownish-yellow color, and over the ring finger is quite gangrenous, and there is involvement of the subcutaneous tissue. The thumb and index finger are not involved.

"*Right hand.*—The dorsum of hand is unaffected. On the

dorsal surface of first and second inter-phalangeal joints of index, middle and ring fingers the skin is thickened, brownish in color, no vesicles. Over the hypothenar eminences on palm is a large area, measuring 5x6 cm., in which the skin is loosened from the subjacent tissue, markedly discolored, and at one point a serous fluid is exuding. The palmar surface of all four fingers shows a gangrenous condition of the skin with vesiculation and oozing of fluid, most extensive on ring finger, where the process invades the palm of the hand.

"*Right foot.*—Over dorsum of foot, below ankle, is an area, 5x3 cm., in which the skin is gangrenous and exceedingly black; slough still adherent to adjacent tissue; surrounding skin, slightly pigmented. Over the heel there is an area of brown, discolored, thickened skin, measuring 5x6 cm.; this area is sensitive to the touch.

"*Left foot.*—Below external malleolus is an area, 5x3 cm., of gangrenous and sloughing black skin.

"*Left buttock.*—Just over the spine at the junction of the dorsal and lumbar regions there is a patch of dry gangrenous skin 1½x2 cm. Over left gluteal region there is an irregular gangrenous patch, quite dry, measuring 4½x2 cm., slightly sensitive to pressure.

"*Occiput.*—Over the lower part of occiput, on each side, there are two areas in which the scalp has a gangrenous appearance, slight oozing of fluid causing matting of hair."

Though the history did not suggest malaria, as in the routine examination of the abdomen the spleen was found to be considerably enlarged, the blood was at once examined, and very large numbers of æstivo-autumnal organisms were found. The crescents were in unusually large numbers. Cultures taken from the blood proved negative. There was no leucocytosis, and the differential count was practically normal. The eosinophiles were only 2 per cent. The patient was at once given quinine in full doses, and he began to improve rapidly. The larger sloughs were treated with linseed poultices made with bichloride solution. Crescents and ovoids persisted in the blood for some time, though by December 15th they were rapidly disappearing. On December 14th, the gangrenous patches on both hands had healed. On the feet the sloughs had separated, leaving deep ulcers, the sheaths of the tendons being exposed. The urine examinations were negative throughout. The patient had a slight rise of temperature (100°) at first; subsequently none at all. The figures from photographs, by Dr. Brownell, illustrate the condition on admission.

BENJAMIN JESTY: A PRE-JENNERIAN VACCINATOR.

BY THOMAS McCRAE, M. B., (Tor.), *Instructor in Medicine and Physician in charge of the Clinical Laboratory, The Johns Hopkins Hospital.*

"That a disorder communicated to the human animal from one of the brutes should protect the former against the contagion of small-pox, is one of the most interesting facts in the whole history of medicine. How glimpses of a truth so remarkable were first revealed to the casual observation of certain peasants, and how the result of this chance observation was gradually 'matured into a

rational and scientific form by a mind deeply imbued with the best principles of sound philosophy,' I have not leisure to tell you in detail."—(Watson's Practice of Physic.)

Tradition has it that there were many instances of the "glimpses" of the truth of vaccination referred to by Watson,

[Copy of print in the Fisher Collection at the Johns Hopkins Hospital.]



PAINTED BY M. W. SHARP.

ENGRAVED BY W. SAY.

TO THE PRESIDENT, VICE-PRESIDENTS, TREASURERS, TRUSTEES, AND
MEDICAL OFFICERS OF THE ORIGINAL VACCINE INSTITUTION,

This Print of Mr. Benjamin Jesty, from a Picture in the possession of the Institution, is respectfully inscribed by their devoted Serv't,

WILLM SAY.

Mr. B. Jesty, Farmer of Downshay, Isle of Purbeck, Aet. 70, who inoculated his Wife and Two Sons for the Vaccine Pock in 1774, from his Cows at that time disorder'd by the Cow Pock, and who subsequently, from the most rigorous Trials have been found unsusceptible of the Small Pox Having rationally set the Example of Vaccine Inoculation from his own knowledge of the fact of Unsusceptibility of the Small Pox after casual Cow Pock in his own person and in that of others, and from knowing the harmlessness of the Complaint. To commemorate the Author of these historical truths the Vaccine Institution have procured this Portrait.—*Extract from the Minutes of the Original Vaccine Institution, Broad Street, Golden Square, September, 1805.*

London, Published Decr 1st, 1805, by the Engraver, 92 Norton St., Marylebone. 1737-1816.

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long before the great work done by Jenner. But the majority of these lack certain proof as cases of the employment of the inoculation of cow-pox as a preventive of small-pox. However, the evidence regarding the subject of this sketch seems thoroughly authenticated, and there can be no doubt of Jesty having performed vaccination in 1774. The date of Jenner's first vaccination was 1796, although for many years before he had been making observations regarding it. The material relating to Jesty has been very fully collected by Crookshank in his work on "The History and Pathology of Vaccination," from which much of my information is obtained. Jenner appears to have regarded the account of Jesty as an invention likely to detract from the credit due to himself. But it can in no way lessen Jenner's fame. The early instances were only isolated occurrences without influence further than their own surroundings, while Jenner introduced vaccination and gave it to the world.

Benjamin Jesty was born at Yetminster in Dorset, and was a farmer. Subsequently he moved to the farm of Downshay in the Isle of Purbeck, in Dorset, situated not far from Swanage. Judging from what has come down to us concerning him, he appears to have been an eccentric man, full of quaint ways of action and speech, but with a good share of the power of observation and of sensible reflection over what he had observed. In 1774, small-pox was prevalent in his locality. He was thought to be in no danger of it himself, having had the cow-pox previously by taking it casually from the cows. This was a matter of tradition through the countryside. Some of his family were not so protected, and the fact that two of his maid-servants, who had previously had the disorder from the cows, attended patients suffering from small-pox without infection, seems to have determined Jesty to inoculate the cow-pox into his own family as a preventive of small-pox. The farmer is said to have argued thus: "For his part he preferred taking infection from an innocuous animal like the cow, subject to so few disorders, to taking it from the human body, liable to so many and such diseases, and that he had experience on his side, as the casual cow-pox was not attended with danger like the variolous infection; and that beside there appeared to him little risk in introducing into the human constitution matter from the cow, as we already eat the flesh and blood, drink the milk and cover ourselves with the skin of this innocuous animal." (Extract from the communication of Rev. Dr. Bell).

Accordingly, Jesty carried out his ideas and inoculated his wife and two sons, aged two and three years, with the cow-pox. The patients went into the fields, and the virus was taken on the spot from the teats of the cows. A stocking-needle was the instrument used; Mrs. Jesty being inoculated under the elbow, the sons above. The latter had the disorder in a favorable way, but in the course of a week Mrs. Jesty's arm was much inflamed. She had fever, and was so ill that a neighboring surgeon, Mr. Trowbridge of Cerne, was called. He said "You have done a bold thing, but I will get you through it if I can." She soon recovered perfectly. Dr. Bell states that the oddness and novelty of the attempt produced no small alarm in the family and no small sensation in the neighborhood. Fifteen years later, in 1789, the sons were inoculated for the small-pox by Mr. Trowbridge, along with others who had not

had the cow-pox. At this time the inoculation of small-pox was a common procedure. The arms of the Jests were inflamed, but this soon subsided, and no fever or other variolous symptoms were observed. The unprotected individuals went through the usual course of inoculated small-pox. Subsequently Mrs. Jesty and her sons were often exposed to small-pox without taking it, while in 1805 one of the sons was inoculated for small-pox with a negative result.

It is a wonder, as Dr. Bell notes, that nothing of these cases was known to Jenner, as they would have been valuable evidence in support of his doctrines of the value of vaccination. But when one considers the means of communication of the day, it is easily understood why this experiment of a south-of-England farmer should have only become known to a very local district. Statements regarding these facts were drawn up in 1803 by Dr. Bell and Mr. Banks, the member for Corfe Castle, which is close by. These came before a committee of the House of Commons and the Jennerian Society. In 1804, the Society endeavored to get Jesty to come to London in order that they might see him and investigate the matter, but an attack of gout prevented. The following year the secretary of the society wrote:—

LONDON, *July 25th*, 1805.

Sir:—I am desired to propose to you that, provided you will come to town at your own convenience, but as soon as possible, to stay not longer than five days unless you desire it, for the purpose of taking your portrait as the earliest inoculator for Cow Pock, at the expense of the institution, you will receive 15 guineas for your expenses and the members of the establishment will be happy to show you any civility during your stay in London, on which account it is hoped you will be put to little or no expense.

I have the honor to remain, Sir,

Your obedient humble servant,

WILL SANCHO.

Mr. Jesty accepted the invitation and journeyed to London, taking one of his sons with him. It is stated that they met with great attention from the members of the Jennerian Society who were much amused by Jesty's ways. Some idea of his characteristics is given by various incidents reported. His family tried to induce him before coming to dress more fashionably, but he said "he did not see why he should dress better in London than in the country." Mr. Colson writes that on his return he gave a very unfavorable account of the metropolis, but said there was one great comfort there, viz., that he could be shaved every day. While there he was inoculated for the cow-pox, and his son for the small-pox, but neither took effect. This was done by the Society probably for the sake of their investigations. Mr. Jesty was presented with a pair of very handsome gold-mounted lancets, and his portrait was taken by Mr. Sharp; but he proved an impatient sitter, and it is said would only be kept quiet by Mrs. Sharp's playing on the piano for him. The portrait was presented to the Vaccine Institution, and is said by Crookshank to be now in the possession of Jesty's great grandson. There is an excellent copy of it in the Fisher collection of medical portraits in the Hospital.

The members of the Jennerian Society drew up a statement which among other things testified—"that Jesty had given decisive evidence of having vaccinated his wife and two sons in 1774, who were thereby rendered unsuspceptible of the small-

pox as appears from their frequent exposure and inoculation. He was led to this from knowing the common opinion regarding the protection of cow-pox against small-pox and that he himself for the same reason was incapable of taking small-pox and from observation of the same thing in others. He believed that cow-pox was free from danger and that by it he should avoid various human diseases, such as the evil, madness, lues and many bad humors as he called them." The year after his visit to London, Jesty seems to have suggested an application for some pecuniary reward, but as the secretary of the Vaccine Institution considered any grant improbable, the matter was dropped.

Last summer, in company with Dr. Osler, a visit was made to the locality where Jesty lived. To-day, the ordinary native of the district does not know the name of Jesty. His farm, Downshay, is in the Isle of Purbeck in the county of Dorset. It occupies a delightful situation in a valley between the Purbeck Hills and Nine Barrow Down, a few miles from Corfe Castle. Leaving the Kingston road, the house is reached by a rough way through the fields with many steep descents. It is not seen at first, indeed we did not look for it, as our whole attention was centred on the superb outlook. To the left, in the setting sun, were the ruins of Corfe Castle guarding the gateway to the Isle of Purbeck; to the right, Swanage and its bay, with far off on the horizon the white cliffs of the Isle of Wight (The Needles); while across the valley was the fine sweep of the Nine Barrow Down. Encircled by trees and in a depression, we did not see the house until we reached the barnyard, when we were greeted by a jolly looking dairy-man who was just driving out his herd. The entrance to the garden was through a fine old stone gateway with pillars of a quaint design. The house was of a type common on the island, of two stories

and well built, looking very fresh and clean after its more than 250 years. The date of building, 1635, was carved on the side of the house.

From the farm-house, a drive of a few miles brings one to the village of Worth Matravers where Jesty is buried. This is situated on the point of land known as St. Alban's Head. Here, in the parish church, a picture of Jesty with a suitable inscription is found hung up in the vestry. In the church-yard adjacent is his grave with that of Mrs. Jesty alongside. His tombstone bears this inscription:—

SACRED
TO THE MEMORY
OF
BENJⁿ JESTY (OF DOWNSHAY)
WHO DEPARTED THIS LIFE
April 16th, 1816
Aged 79 years.

He was born at Yetminster in this County and was an upright honest man, particularly noted for having been the first person (known) that introduced the Cow Pox by inoculation and who, from his great strength of mind, made the experiment from the cow on his wife and two sons in the year 1774.

One feels that Jesty was in advance of his generation, and a man who saw probably better than he knew. He did his little to blaze out the path which has since become a highway. That he could do but little to advance vaccination, his circumstances decided. To another was the honor of giving vaccination to the world.

HÆMOPHILIA IN THE NEGRO.

BY WALTER R. STEINER, M. D.

Although the disease hæmophilia appears to have been known since the time of Albucasis,¹ the great Arabian physician, yet the two, or possibly three, cases reported before Fordyce's² short article appeared, contain no real contribution to the study of this disease. In the year 1784, its hereditary character was pointed out by Fordyce. Nineteen years later the term "bleeder" was given by Otto³ to those who had hæmophilia, and in addition to this he showed the general immunity of the females and their tendency to transmit the bleeding disposition to their offspring. Following these writers a number of American and German physicians did much in contributing to the knowledge of this disease. Schönlein⁴ named it "hæmophilia" about 1828, and gave it a place in his text-book on "Pathology and Therapeutics." Its later history is closely associated with the name of the British physician J. Wickham Legg.⁵

The first attempt to collect all of the reported cases was made by Naas,⁶ in Germany, in a paper published in 1820. He also endeavored to give a systematic description of the affection.

This work was followed by other statistical articles by Lange,⁷ Grandidier,⁸ and Dunn,⁹ the last appearing in 1883.

Many cases have been reported among different races. The Anglo-Germanic race has furnished most of them, followed by the Latin, Scandinavian and Teutonic races. Individual instances have also been given by Heymann¹⁰ in a Mohammedan family from Palembang, on the Island of Sumatra, where this diathesis was found in three generations, and by Koch¹¹ in a possible case of hæmophilia in a creole from Port of Spain, Trinidad. But in all the literature on the subject there is but one well-defined case in the negro mentioned.

This case was reported by Dr. Hadlock¹² before the Academy of Medicine of Cincinnati, on November 16, 1874. The patient was a mulatto boy, aged seven years, who was found, on the doctor's visit, to be bleeding from the mouth. On examination Dr. Hadlock considered the hæmorrhage due to a decayed snag of a tooth which had become loosened. The tooth was accordingly extracted with the result that the hæmorrhage became alarming in character. A compress steeped

in a solution of the persulphate of iron checked it for a time, but on the next day it seemed to be more violent than ever. The bleeding point was then cauterized and astringents were also given, all of which succeeded in arresting the hæmorrhage temporarily. It recurred again, however; all efforts to check it were in vain, and the boy died in forty-eight hours. "On inquiring into the history of the boy's family" Dr. Hadlock found "that many of its members had died from hæmorrhage from slight wounds. An uncle had cut himself with a scythe and died in consequence. His father had received a slight scratch from a briar and bled to death."

The following case, which was admitted to the Johns Hopkins Hospital on April 10, 1899, is consequently the second to be recorded in the negro race.

Alverta W., aged 14 years (Medical History, No. 9764), complains of hæmorrhage from the nose and mouth, and headache.

Family history (obtained mostly from patient's mother).—Father, mother and two brothers, alive and well; a sister died of throat trouble, aged 6 years. No history of tuberculosis, rheumatism, or any neoplasm in the family.*

Hæmophilic history.—Patient's great-grandmother was a bleeder from early childhood till her death, June 8, 1898, from old age and la grippe. Her doctor frequently told her the bleeding was due to the fact that she had "too much blood." Patient's mother (Alverta S.) says she can distinctly remember the doctor coming about twice a year to remove some of this "too-much blood," by cupping or leeches. The great-grandmother had fourteen children, ten boys and four girls. Of these, the patient's mother remembered the names of eleven only, seven boys and four girls. (See family tree.) The seven known personally to the patient's mother were all of them bleeders, and are now all dead but William T. One of the sons, Mose, died from hæmorrhages from the nose and mouth in 1895, in Philadelphia, at the age of thirty-four years. He had had hæmorrhages from early childhood, but during his last five years they were more severe. The doctor told his wife he did not have consumption, but what diagnosis was made of the case is unknown. The patient's grandmother used to bleed from the nose occasionally. She died December 30, 1898 (aged 60), of "asthma, dropsy, Bright's disease and heart disease."

Patient's mother frequently bled from the nose till her sixteenth year. She has had no attacks since.

Patient's brothers have occasional attacks of epistaxis, and bleed considerably from the slightest cuts and bruises.

Past history.—As a child, had measles, mumps and whooping cough. "Ulcerated sore throat" of two weeks' duration

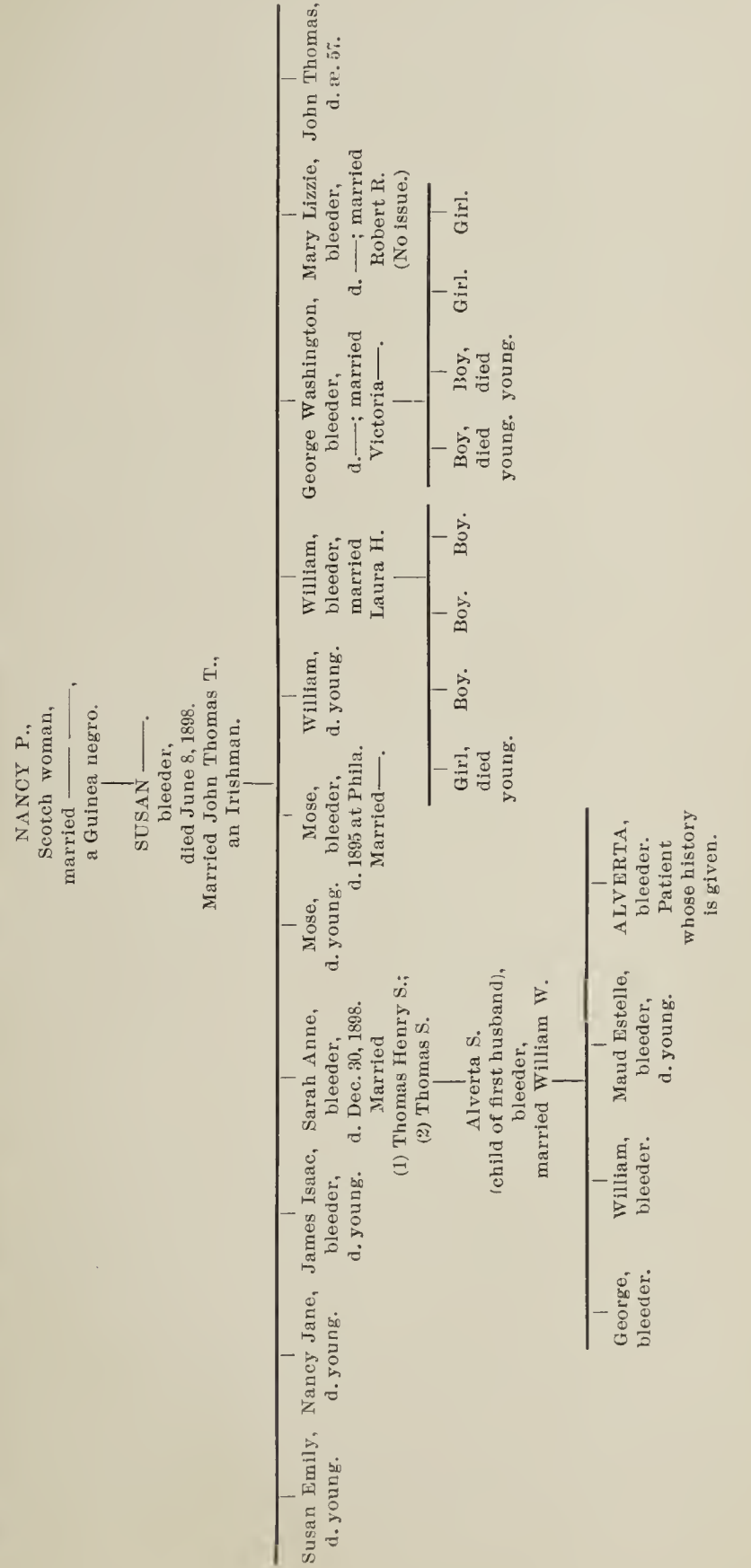
* One brother, William W. (Surgical History, No. 9080), was later admitted to the Johns Hopkins Hospital, on the surgical side, complaining of a swollen right ankle. He gave the history of an attack of gonorrhœa one month previously. The swelling in the ankle seemed located in the tissues about the joint, there being apparently no effusion in the joint itself. The diagnosis of gonorrhœal arthritis was made. Patient left the Hospital July 3rd, against advice, being only slightly improved. In view of the occurrence of joint troubles in hæmophilia, added interest is given to this case.

one year ago. She gives a somewhat indefinite history of malaria in the spring of 1896. No chills, but thinks she had chilly sensations and fever. Was living in Baltimore at the time.

She has been a sufferer from severe frontal headaches ever since she can remember.

Menstruation has not yet been established.

Hæmophilic history.—Has bled easily from the slightest scratches since early childhood, but the amount of blood lost



has been very slight in every instance. No attacks of epistaxis till present illness.

Present illness.—About two and a half months ago, she woke up one morning and found her pillow and night-dress bathed in blood, which came from her nose. By eating some salt, she checked the hæmorrhage after she had bled about a cupful. Since then she has not enjoyed her customary good health, but has felt very weak and drowsy. Five days prior to her admission to the Hospital, she was awakened by an attack of epistaxis. It started with a sudden gush of blood, but soon amounted to only a slight ooze, and so continued for three days. Salt was also used on this occasion, but to no purpose.

Two days after this, she found she had had her third nose-bleed, during the night. It was very slight, however, and she was not awakened by it. In all, she thinks she lost about "half a wash-basin of blood."

Her only symptom in these attacks has been constant frontal headaches.

No bleeding from, or swelling of her gums, has ever been noticed, nor has any blood ever been detected in her urine or fæces. On admission, temperature, 100.4°; pulse, 104; respiration, 24.

Physical examination.—Patient is a quite well-developed, dark-skinned negro girl. Lips and mucous membranes are rather pale. Her tongue has a reddened, glazed appearance. The gums are swollen, and inflamed, but no bleeding points can be seen, nor can the gums be made to bleed on pressure.

Thorax.—Negative on examination. Pulse 100 to the minute, regular in force and rhythm, good volume and tension.

Abdomen.—Negative.

Extremities.—Negative.

No petechiæ or purpuric spots seen anywhere.

Blood examination negative for malarial parasites. Leucocytes, 10,500. The day following admission, a small herpetic area was noted on her lower lip. The nose examination was negative. Four purpuric spots, about 2 mm. in diameter, were seen about the right clavicle.

Blood examination.—Coagulation time, between 3-4 minutes; red blood corpuscles, 5,088,000; white blood corpuscles, 4,500; hæmoglobin, 60 per cent.; blood platelets, 212,000.

On the third day a few additional purpuric spots were seen about the flexor and extensor surfaces of both arms and legs, at the elbows and knees. For the past two nights there has been slight bleeding from her gums.

On April 14th, the following note was made by Dr. Fletcher: Patient's gums are still distinctly swollen, but less so than on admission. They bleed easily on pressure.

Seven days later the gums were considerably less swollen, and could not be made to bleed on pressure. At the time this note was made, patient had been up and about the ward for four days.

Blood examination, April 23.—Red blood corpuscles, 5,020,000; white blood corpuscles, 6,000; hæmoglobin, 47 per cent.; blood platelets, 280,000.

The patient improved wonderfully during her stay in the Hospital, and was discharged April 24th. No more petechial spots were noted after those seen April 12th, and those then seen quickly vanished.

Urine.—On entrance the urine was straw-yellow in color, clear, 1021 in specific gravity, faintly acid in reaction, negative for sugar, but contained a trace of albumen. There was a white flocculent precipitate. Microscopically a few hyaline and granular casts were seen as well as a number of epithelial cells, and calcium oxalate crystals. Mucous strands were also seen. The urine gradually cleared up, and on the last examination (April 21), no casts nor albumen were found. Her temperature nine hours after admission rose to 101.2°, but gradually fell till the next day, when it was 99.8°. From this time on there were daily elevations, the highest point reached being 100.7° on April 14th.

Treatment.—Patient was given calcium chloride (grs. xv t. i. d.), a drug which was first introduced by Wright¹³ for the treatment of this disease. It was given in the following prescription, as advised by Wright:

R	Calci chloridi,	-	-	-	3iii.
	Aquæ chloroformi	-	-	-	3ii.
	Aquæ aurantii florum,	-	-	-	3iv.
	Aquæ q. s. ad.	-	-	-	3vi.
	M. S. 3ss. t. i. d. p. c.				

It is interesting to note that both the cases of hæmophilia were not in patients of pure negro blood.

In a study of the family tree of the second case we find:

(1.) The extraordinary fertility of bleeder's families (a fact first pointed out by Wachsmuth¹⁴) is well shown in the family of our patient's great-grandmother. Five of her children died early, and none of the others, save one, now survives.

(2.) Of these, three children out of the six known to patient's mother died young. This accords with the fact that a large percentage of the bleeders die early.

(3.) Contrary to the usual statement, both the males and the females seem to have been bleeders, but only one (a male) died from the effects of hæmorrhages.

(4.) The preponderance of the males is seen in two of the families named. This excess of sons over daughters has been given as a reason for the rarity of this disease.

(5.) The bleeding tendency in each instance was transmitted through the females.

In conclusion, I wish to thank Dr. Osler for allowing me to report this case.

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11. Koch: Brit. M. J., Lond., 1890, 1, 1301.
12. Hadlock: Clinic, Cincin., 1874, VII, 241.
13. Wright: Brit. M. J., 1891, II, 1306.
14. Wachsmuth: Zeitschr. d. deutsch. Chir. Ver., Magdeb., 1849, III, 459-517.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

ROBERT L. RANDOLPH, M.D. Acoin: A New Local Anæsthetic.—*The Ophthalmic Record*, Chicago, August, 1899.

Acoin in solutions of 1:100 and 1:300 produces satisfactory anæsthesia in an unirritated eye in about the same length of time as cocaine.

2. In more than one case where the eye was congested, repeated instillations of acoin were inadequate to produce satisfactory anæsthesia.

3. Inspection of the cornea with a high-power lens failed to show any defects in the epithelium after its use.

4. Acoin has no effect upon accommodation.

5. It has no effect upon the size of the pupil.

6. It does not increase the intra-ocular tension.

7. Several experiments demonstrated that the staphylococcus pyogenes albus did not grow in agar which contained acoin in the proportion used in the clinic, and, furthermore, that exposure of this organism to the action of acoin for twenty-four hours was followed by death of the organism. This would look as though acoin were not only an inhibitor of the growth of this organism, but that it also killed this organism after a certain length of time. It is evident that conclusions drawn from this limited experience with acoin may have to undergo more or less modification with further trial.

——— Expulsive Intra-ocular Hæmorrhage after Preliminary Iridectomy for Cataract.—*The Ophthalmic Review*, London, December, 1899.

The case reported was an old lady of 76. She was exceedingly nervous and refused to enter the hospital, but preferred remaining at home and being nursed by members of her own family. From the uniformly favorable results attending preliminary iridectomy for cataract, this operation was first performed with intention of removing the lens a few weeks later. The operation was perfectly smooth. On the morning of the third day, it was found that the anterior chamber was almost completely obliterated, and that the lens was pressed so far forward as to force the iris against the posterior surface of the cornea. The condition grew worse, till the lens was almost forced through the old wound, when it was thought best to remove the lens. This was done and immediately there was a flow of bloody vitreous. Oozing kept up for four days. Light perception was gone, and in six months the eye had shrunk to half its original size. Six months later glaucoma appeared in the other eye. She was unwilling for iridectomy, and with the history of the fellow eye it was thought best not to urge such a measure. The development of glaucoma in this eye justifies us in concluding that the same condition was present, in a less advanced stage, in the right eye at the time of the preliminary iridectomy. The case is of exceptional interest inasmuch as the hæmorrhage followed iridectomy, for, as a rule, such catastrophies are seen only after removal of the lens. It is interesting to note the fact that intra-ocular bleeding did not commence till hours after the iridec-

tomy. The nature of the trouble was not suspected till the morning of the third day, when the evidence of pressure behind the lens was unmistakable, so that bleeding must have been going on intermittingly for days before the lens was removed. The constant reduction of intra-ocular tension caused by the yielding of the eyeball at the point of the wound would explain the persistent character of the hæmorrhage. It is needless to add that we undoubtedly had in this case senile degeneration of the blood-vessel walls—so strong a predisposing cause to such results.

F. H. VERHOEFF, Ph. B., M. D. Shadow Images on the Retina.—*Psychological Review*, January, 1900.

The usual pin-hole experiment is produced by pricking a small hole in a card, which is then held before the eye, but within the point of distinct vision. Under these conditions, if a pin is held between the hole, which serves as a source of light, and the eye, it casts an erect shadow upon the retina, and this shadow is projected as an inverted image of the pin. This experiment was described and explained by Le Cat in 1740. It is possible, however, that he was not the first to describe it, for he does not, in his work, claim that the experiment was original with him.

To show the dependence of the position of the projected image upon the relative position of the pin-hole, the experiment may be modified in the following interesting way. If, for instance, the eye is focused for the near point and the pin-hole is held beyond this point, the shadow of an interposed pin will appear erect. Under these conditions, if the pin-hole is gradually brought closer to the eye, the image of the pin becomes more and more blurred and finally disappears when the hole is at the near point, that is, when the eye is accommodated for the source of light. If the hole is brought still nearer, the original experiment is reproduced, the image of the pin again appears but is now inverted. This experiment is rendered easier if the accommodation is assisted by a convex lens, one of about ten diopters being very convenient. The lens is held close to the eye and the pin in front of the lens, or better, immediately behind it. Then if the pin-hole is placed beyond 10 cm. from the supposedly emmetropic eye, it will appear out of focus and the shadow will be upright. As it is brought closer, the phenomenon just described takes place.

If a sheet of white paper or a piece of ground glass is taken, and a small black spot is made upon it about the size of a pin-head, and this spot is used in place of the pin-hole in the above experiment, a white streak will be seen crossing the black spot. The phenomenon is best obtained without a lens, and is not an easy thing for most persons to see, since it requires that the accommodation shall be relaxed at will. This white shadow behaves in exactly the same manner as does the black shadow in the pin-hole experiment—under the same conditions it may be seen upright, inverted, or be made to disappear. The experiment should be conducted in a good light, and a piece of white paper about five centimeters square should be used. This phenomenon may also be obtained with a photographic camera.

The explanation of this phenomenon lies in the fact that the black spot, under the conditions mentioned, produces only a blurred image upon the retina, and while the interposed pin reduces the illumination of the margins of the spot, it has no appreciable effect upon the middle of the latter, the resulting difference in illumination thus producing the appearance of a white streak.

If a sufficiently large spot is used, it will be noticed that on relaxing the accommodation, the center (of its image) appears much darker than the rest of the image. This is due to the fact that as the spot is made larger it cuts off more and more rays which otherwise would have reached the center of its image, and when it is as large as the pupil, it cuts off all the rays parallel to the primary axis, thus producing a small spot in the center of its image totally devoid of light. But even when the spot is much less than half the size of the pupil, the image appears darker in the center, since many rays will even then be cut off from the center of the image. This circumstance explains the fact that if a moderately large black spot is used for the shadow experiment, the white shadow of the pin is broken by a dark central spot into two white lines, somewhat resembling crescents. If a large black spot with a small white one in the center is used, the appearance of these two crescents may be obtained, and in addition the usual black shadow is seen over the central white spot.

If, in place of a spot, a black line is used, the pin will produce a white line running down the middle of its image; the shadow in this case is more marked and more easily obtained than when a small black spot is used. Two lines drawn at a slight angle to each other, will give a bend in the white shadow at their intersection, but the shadow leaves one or both of the lines at a certain distance from this point. When a narrow red line is used instead of a black one, and a lens is employed to aid the eye, the white shadow takes on a greenish or bluish color. By the use of a lens a narrow line may be so blurred as not to be seen, but a pin in front of the eye decreases so much the amount of light reaching the lateral portions of the image on the retina, as to produce the appearance of a well-defined white shadow. The same thing is also true for a point.

Scheiner's experiment in which two pin-holes placed close together are held before the eye and a double image of a pin is produced, may be explained in the same way as the white shadow just considered, since the two images obtained of the pin may be regarded as one image with a white shadow down its middle produced by the portion of the card-board between the two pin-holes.

When simply blurring a line by relaxing the accommodation, it can be noticed that if the line is not too large, one can always

obtain a white line running down its middle, and within this line a faint dark line. In the case of a small black spot, a white spot is obtained in the center of its blurred image. This is probably due in most part to the denser and probably less transparent nucleus of the crystalline lens shutting off more rays than the rest of the refractive apparatus of the eye. This appearance is not produced by a photographic camera and hence must be mainly due to some such peculiarity of the eye as that suggested. It is possible, however, that the positive aberration of the eye may play some part in its production.

THOMAS R. BROWN, M. D. Recent Work in Typhoid Fever.—*Maryland Medical Journal*, January, 1900.

ARTHUR W. ELTING, M. D. The Antitoxin Treatment of Tetanus.—*Albany Medical Annals*, January, 1900.

T. CASPAR GILCHRIST, M. D. Progress in Dermatology.—*Maryland Medical Journal*, January, 1900.

WILLIAM G. MACCALLUM AND THOMAS W. HASTINGS, M. D. Acute Endocarditis caused by *Micrococcus Zymogenes* (Nov. Spec.), with a Description of the Micro-Organisms.—*Journal Experimental Medicine*, September-November, 1900.

WILLIAM OSLER, M. D. The Home Treatment of Consumption.—*Maryland Medical Journal*, January, 1900.

— A Rhode Island Philosopher (Elisha Bartlett).—*The Boston Medical and Surgical Journal*, January, 18 and 25, 1900.

STEWART PATON, M. D. Certain Essential Points in the Technic of Staining Nerve-Cells.—*Philadelphia Medical Journal*, January 13, 1900.

ROBERT REULING, M. D. Pathology and Bacteriology.—*Maryland Medical Journal*, January, 1900.

WILLIAM R. STOKES, M. D. Recent Advances in the Study of Tuberculosis.—*Maryland Medical Journal*, January, 1900.

HUGH H. YOUNG, M. D. Recent Reports on the Operative Treatment of Hernia.—*Maryland Medical Journal*, January, 1900.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Exhibition of Medical Cases.—DR. FUTCHER.

During the past three or four months we have had a number of interesting cases of embolism and thrombosis in the medical wards. A brief report of these cases may be of interest.

CASE 1. Thrombosis of the left external jugular subclavian and axillary veins, associated with mitral stenosis, with subsequent embolism of the left popliteal artery.

One of these cases was referred to, at a previous meeting, by Dr. Welch when speaking of thrombosis of the veins of the upper extremity associated with heart disease. The patient, a woman aged 35, had had an attack of chorea when seven years

old, and previous to admission had several attacks of acute articular rheumatism. There were marked signs of mitral stenosis with a rapidly-acting heart and cardiac hypertrophy. The first point of interest in the case was the development of some swelling over the left side of the neck, first seen on January 19th, 1899, two weeks after her admission. She complained of slight pain in the left side of the neck and down the inner part of the arm. The pain and swelling gradually increased, so that within a week there was very marked swelling over the left side of the neck, shoulder, arm and dorsal surface of the fore-arm. There was marked tenderness over the sternocleido-mastoid muscle and along the course of the external jugular vein. There was no special elevation of temperature

duing the attack. There was no doubt that the patient was suffering with thrombosis of the external jugular vein and, also, apparently, of the subclavian and axillary veins.

Thrombosis of the peripheral veins in cardiac disease is more common in the upper than in the lower extremities. According to Bouchut, the ratio of thromboses of the veins of the upper extremity to those of the lower is placed at 1 to 50, but in cardiac disease the ratio is decidedly reversed. Dr. Welch was only able to find 26 cases in the literature of venous thrombosis of the peripheral veins in association with heart disease, and of those, 17 were in the veins of the neck or upper extremity, and it is interesting to note that the left side is much more frequently involved than the right.

To return to our case, by March 13th all the local symptoms had subsided and nothing of special importance developed until November 24th, 1899, when, at 12 o'clock, the patient suddenly complained of intense pain in the left foot, associated with a feeling of the pricking of pins or needles and some numbness. I was in the ward at the time the pain came on, and examined the foot, but nothing could be made out by the examination. The pain continued very severe during the afternoon, and at 4.30 P. M. the foot and leg still showed no changes on inspection. The next morning there was marked cyanosis of the left lower extremity as high as the tubercle of the tibia; the foot was cold, and there was great tenderness over the dorsum of the foot and about the shin. Dr. Osler saw the patient and made a diagnosis of embolism of the popliteal artery. The femoral artery pulsated, but there was no pulsation of the popliteal. The next day, November 26th, contrary to expectations, the cyanosis had largely disappeared, and the foot had become almost as warm as that of the other side. From that time on the symptoms gradually subsided, though she still has paroxysms of acute pain at times. The point of interest in connection with the case is the recovery without local gangrene. A great many of these cases result in gangrene of some portion of the extremity. In embolism of the arteries the onset of pain is usually very sudden, differing in this respect from thrombosis, where the pain is more gradual in its development.

CASE 2. Thrombosis of the left femoral vein in a case of pulmonary tuberculosis. This condition is not so very uncommon in tuberculosis, usually occurring in the veins of the lower extremities. The patient, a man 55 years of age, was admitted Oct. 22nd, with marked signs of advanced pulmonary tuberculosis. About two weeks after admission, he began to complain about midnight of severe pain in Scarpa's triangle. The next morning his leg was definitely swollen, being 3 cm. larger than the other leg at the calf. The superficial veins were distinctly dilated, and the temperature on that side was, if anything, a little higher than that of the other leg, though there was no change in its color. The pain persisted for about ten days. The swelling has gradually diminished, and at present there is a definite thickening to be made out along the course of the femoral vein. Thrombosis in tuberculosis is generally held to be due to the development of marantic thrombi. Dodwell and others think that they are of infectious origin due to various pyogenic micro-organisms. Arterial thrombosis in tuberculosis is a rare event. It occurs most commonly as a thrombosis of the pulmonary artery or its branches in tuber-

culosis of the lungs. Very rarely it occurs as a result of tuberculous involvement of the intima of the arterial walls.

CASE 3. Thrombosis of the right axillary and brachial veins, occurring in the course of a malarial nephritis. The patient, a man aged 39 years, was admitted Oct. 16th, 1899, suffering from malarial nephritis. He had a marked amount of albumen in the urine, with numerous casts. He was distinctly anæmic, showing less than 3,000,000 red blood corpuscles, and about 50 per cent. of hæmaglobin. *Æstivo-autumnal* malarial parasites were found in the blood. On Oct. 18th, it was noticed that the right arm was somewhat swollen, and this condition increased during the next three or four weeks to such an extent that it was deemed necessary to make incisions in the skin to let out the fluid. Considerable relief followed this procedure. The swelling eventually diminished, and, although suspicion was entertained of a venous thrombosis, it was not until the œdema had markedly disappeared that a marked thrombosis of the right axillary and brachial veins was found to exist.

Just what the cause of the thrombosis was in this case is hard to say. It is doubtful whether malaria had anything to do with it. French observers have claimed that malaria does, at times, cause a thrombosis of the veins, but Dr. Welch is inclined to believe that there is really no relationship between the malaria and the thrombosis in these cases. In over 2000 cases of malaria in Dr. Osler's department, no instance of thrombosis was found. It is probable that the thrombosis in this case was due either to the nephritis or to the anæmia.

NOTES ON NEW BOOKS.

Annual and Analytical Cyclopædia of Practical Medicine. By CHARLES E. DE M. SAJOUS, Philadelphia. (*Philadelphia: The F. A. Davis Company*, 1899.)

This is the fourth volume of the publication and includes subjects from "Infants, Diarrhœal Diseases of," to "Mercury." In a work of this kind a uniform excellency is not to be expected, but in this volume the editor is to be congratulated on the general high character of the articles. The task set is no easy one—to embody much in small space, and to make satisfactory extracts from large numbers of articles. The editor notes in the preface the death of one of his associates, Dr. Rohé of Baltimore, who contributed the article on "Insanity" in this volume. It is one of his last contributions.

The volume opens with an article on "The Diarrhœal Diseases of Infants," by Dr. Blackadar, of Montreal, which is full of practical points. The sections on classification and treatment are especially good. "Intubation of the Larynx" is treated of by F. E. Waxham of Chicago. This is an excellent paper and especially so in its practical character. We should like to draw attention to this feature which is often lacking. Too rarely do writers bear in mind that those who will profit by their articles have had little or no experience in the subject discussed. Details which to the experienced writer seem trivial or unnecessary are really the essential parts for the reader. Dr. A. McPhedran of Toronto, contributes two excellent articles on "Jaundice" and on "Diseases of the Liver and Gall-Bladder." He has succeeded in giving much matter in small space, and has made very comprehensive selections from the literature. The longest article is that on "Malarial Fevers" by Drs. J. C. Wilson and T. G. Ashton of Philadelphia. They have given a very full account of the disease and of the latest

investigations as to the manner of infection. The plates used to illustrate the parasites are those of Mannaberg's recent work.

It is not possible to refer to all the articles in detail; those of W. B. Pritchard of New York on "Locomotor Ataxia" and of C. M. Hay of Philadelphia on "Meningitis" are worthy of notice. Altogether this volume is an excellent one.

A Text-Book of the Practice of Medicine. By J. M. ANDERS, M. D., Philadelphia. Third edition. (*Philadelphia: W. B. Saunders, 1899.*)

The appearance of a third edition of this work shows that there was ample room for it. Many of the articles have been rewritten for this edition and some added. The author pays considerable attention to diagnosis and gives many differential diagnosis tables. We are unable to agree with him as to the value of these. We refer not particularly to these of Dr. Anders, which are good, but to the general principle. Students are too apt to attempt to memorize them, thinking it an easy path to knowledge, only to discover later that their labor has become sorrow. In discussing cardiac diseases he evidently considers the apex diastolic, or so-called Flint murmur, in aortic insufficiency as of rare occurrence, and dismisses it in a few lines. The widely divergent views as to the frequency of this murmur are interesting. The section on "Chronic Valvular Disease" is especially well-put and practical. We should hardly consider "systolic pulsation of the larynx and trachea" as a good description of Oliver's tracheal tugging. It is surprising to find no mention of eosinophilia in the discussion of trichinosis. Throughout the book the sections on treatment are full, comprehensive and practical, which is a most valuable feature.

The Medical Annual Synoptical Index. For the twelve years, 1887 to 1898. (*Bristol, England: John Wright & Co., 1899.*)

This is an index to the contents of the Medical Annual for the years 1887 to 1898. To those who know this work it will be evident to what a large amount of material this index is the key. In addition to its being an index, it also contains many briefly-put extracts regarding new drugs and points of treatment. In the synoptical index these are put in various subdivisions under each heading. By these any special point is readily found. The notes on treatment embody much in small space. A summary of the chief changes in the new pharmacopœia is a valuable feature. There is also a supplementary index giving many cross references. The general plan of the book is excellent, and it cannot fail to be of great help to the busy practitioner. In these days of profuse medical literature, an index such as this is always of assistance.

Bacteriology in Medicine and Surgery. By WM. H. PARK, M. D., Assoc. Professor of Bacteriology and Hygiene, Univ. and Bellevue Hosp. Med. College, New York. (*Philadelphia and New York: Lea Bros. & Co., 1899.*)

Amongst the large numbers of publications appearing every year, dealing with the subject of bacteriology for the use of medical practitioners and students, it is noticeable that the many are of doubtful helpfulness, whilst the lesser numbers only are of real service to the classes which they were intended to benefit.

It is therefore from amidst the latter sort that we single out the work by Dr. Park as worthy the attention of our readers.

It consists of an introduction dealing in an excellent manner with the history of bacteriological science, followed by forty chapters which treat of the general morphology of bacteria, their vital phenomena and their relation to disease, and the biological features of the most important pathogenic varieties; the theories of infection, immunity and recovery; the principles and practice of disinfection; the methods of procuring material for examination; the technique of staining and cultivating the bacteria; and the analysis of air and water. Inclusive is an appendix descriptive of patho-

genic forms of the higher fungi, formerly classified with the bacteria.

Friendly criticism being healthful, we shall briefly deal with the failings as well as the good features of the book.

The subject matter of the chapters descriptive of the general characteristics, morphology, vital phenomena and environments of bacteria, is extensive and so lucid that the reader very readily grasps the various facts set forth. It is only to be regretted that the author did not see fit to have chapters VIII, IX, and XVII incorporated with, or made to follow chapters I, II, and III, as the sequence is undoubtedly marred by the present arrangement.

In like manner, the valuable material in chapters IV, V, VI, and VII, dealing with the relation of bacteria to disease, infection, immunity and recovery, would undoubtedly have been placed to better advantage had chapters IV and VII been combined, and chapters V and VI formed another.

The technique of mounting, staining and examining bacteria is plainly stated in chapter XII.

Chapter XIII deals with the usual methods of preparing media, the technique of inoculating and making plate cultures, and the methods of anaerobic culture. There are an unfortunate obscurity and lack of arrangement in that part dealing with the making of plate cultures, otherwise the chapter is free from faults, though somewhat terse.

A most welcome message is expressed in chapter XV. For what worker in a large laboratory has not at one time or another been greatly annoyed by the display of ignorance by those submitting specimens for examination.

One prominent feature of the book is the treatise on disinfection contained in chapters X and XI. Here we have Dr. Park's valuable and wide experiences in this one matter of Public Health, strongly and succinctly stated; and a careful perusal of these chapters amplifies one's knowledge very considerably. For in most textbooks dealing with bacteriology these important points of practical disinfection are too often passed over hurriedly, or not mentioned.

Another feature worthy of comment is the ample and thorough manner in which the chapters dealing with the biological features of the various organisms, are discussed. Especially would we draw attention to those descriptive of tuberculosis, diphtheria, typhoid fever, pneumonia, gonorrhœa, cholera, glanders and rabies.

Notwithstanding some occasional obscurities in grammatical construction, and what we have considered as shortcomings, Dr. Park's work can be considered as of valuable assistance to those of the medical profession and its students, who stand in need of reliable information and help in pursuing their studies in the important subject of bacteriology.

The book is gotten up in excellent style, being printed upon good paper with clear type, and is well supplied with suitable engravings and half-tone photographs of many of the well-known bacteria.

N. MACL. H.

Diseases of the Nervous System. By LUDWIG HIRT. Translated by A. Hoch, M. D., and F. R. Smith, M. D. (*New York: D. Appleton & Co., 1899.*)

The first English translation of this work appeared in 1893, and from the present title-page it appears that this is in no sense a second edition, but merely a reprint of the first edition; that is, that no essential changes have been made in the text either by the author or his translators, since the book was first published in America.

In the past ten years since the author published his volume first in Germany, the advances in neuro-pathology have been enormous, but though we know so much more of the finer anatomical structure of the whole nervous system, yet we are by no means able to use all this accumulated knowledge either in the diagnosis or treatment of

nervous diseases, and it is for this reason that the work under discussion only appears as a reprint and not as a second edition.

But the value of the work is thus in no wise diminished, and as a guide to the study of nervous diseases Hirt's treatise ranks as one of the very best both for the student and specialist in this line of work. The intrinsic merits of the work are clearly set forth in the introduction by Osler, who quotes Weir Mitchell's praise of the book, and the reviewer feels that when two such leaders of medicine unite in commendation of a work, this is the best review that the book can have.

Although the study of nervous diseases is one of the hardest in medicine, yet the style of the author is so clear and easy, that it is a real pleasure to read his volume; which cannot be said of most German works, even when they are so well translated as is here the case. Hirt may fairly be compared with Strümpell in the lucidity with which he writes, and his novel arrangement or description of diseases has a very distinct attraction for the reader, which the reviewer finds makes the study of nervous disorders more comprehensible than is sometimes the case.

The illustrations are excellent, there is a good index, and both type and paper are satisfactory.

Archives of Neurology. From the Pathological Laboratory of the London County Asylums, Claybury, Essex; Edited by FREDERICK WALKER MOTT, F. R. S., M. D., F. R. C. P., Director of the Laboratory, and Pathologist to the London County Asylums; Physician in Charge of Outpatients, Charing Cross Hospital. (Westminster: P. S. King & Son, 1899.)

The tendency toward an increase of laboratory work in connection with neurology and psychiatry in England and America is obvious. While in Germany and in Paris the association of microscopic studies of post-mortem material with careful clinical work in neurology and psychiatry has for a number of years been a prominent feature, England and America have been slower to adopt the plan. Of late, however, vigorous efforts have been made to bring psychiatry in English-speaking countries up to a higher level. The establishment of the pathological institute in New York in connection with the asylums of the state of New York, and the development of a laboratory at the Ohio Hospital for Epileptics, together with the excellent laboratories connected with several Massachusetts institutions—the McLean hospital, Worcester hospital and Danvers hospital,—are notable results of such efforts. Other asylums for the insane and institutions for the care of epileptics and the feeble-minded are rapidly making arrangements for the institution of well-equipped modern laboratories in connection with them.

The publications of the results of studies from such laboratories are beginning to appear. The Bulletin of the Ohio Hospital for Epileptics and the Archives of Neurology and Psycho-pathology from New York are well known to our readers. These, together with the results of research published in Asylum Reports are practically the only representatives in America of a class of publications quite common in Germany. Obersteiner's *Arbeiten*, Wernicke's *Arbeiten*, Pick's *Beiträge*, Henschen's *Studien*, Möbius' *Beiträge*, Kraepelin's *Arbeiten* and other examples will be immediately called to mind.

One of the most important of the more recent laboratory establishments is that in connection with the London County Asylums. The London County Council has authorized the building of a laboratory in connection with the asylum at Claybury in Essex, and has equipped it well for scientific work by modern methods. Autopsies are made at all the asylums, but the laboratory at the Claybury institution is the headquarters for the working up of the tissues. The Council has been fortunate enough to secure as director of the laboratory and pathologist to the asylums, Dr. Frederick Walker Mott, well known in this country as well as in Europe for his important researches in the experimental physi-

ology and pathology of the nervous system. At the end of 1899, Dr. Mott has published a large volume entitled "The Archives of Neurology," which includes the more important researches made in the laboratory by himself and others during the past year. The Archives are to be published annually, and will thus contain the collected papers dealing with the pathological work of the London County asylums.

The first volume includes some twenty-four papers, ten of which bear the editor's name. The papers are all interesting, and a number of them are of unusual importance. Dr. Mott's studies on "Brain Syphilis," on the "Ætiology and Pathology of General Paralysis," on "Juvenile General Paralysis," and on "The Chemistry of Nerve Degeneration," must be studied with care by all who are more than superficially interested in the problems to which these titles refer. Dr. Hamilton Wright contributes valuable papers upon "The Tangential System of Fibres of the Inferior Frontal Convolution in General Paralysis," on "Alcoholic Atrophy" and, in connection with Dr. Mott, upon the "Changes in the Spinal Ganglia and Peripheral Cutaneous Nerves in a Case of General Paralysis with Bullous Eruption." One of the most interesting casuistic reports is that by Dr. Mott dealing with the spinal cord, peripheral nerves and muscles in a case of acute poliomyelitis in which the fatal termination occurred sixteen days from the onset. The sensory ganglia in tabes have been studied by Mr. Salaman. Dr. Barratt describes the results of his observations on the normal anatomy of several cerebral nerves, and also on the amount of water and phosphorus contained in the cerebral hemispheres and spinal cord in several pathological conditions.

The volume is printed upon heavy paper, of good quality, and the articles are liberally illustrated, many of the illustrations consisting of excellent colored plates. The publication can be heartily recommended to all students of neurology and psychiatry, and represents by all odds the most important recent addition to the bibliography of these subjects.

Those interested in the introduction of pathological work into asylums will do well to read the preface to the volume, written by Dr. W. J. Collins, who was formerly chairman of the London County Council. Dr. Collins, after speaking of the importance of the study of the pathological lesions in cases of insanity, describes the origin of the Claybury institution and refers briefly to the plan of the pathological laboratory established there. A significant feature is the endowment by the Technical Education Board of several research scholarships. The fact that such well-known names are connected with these scholarships proves the desirability of such endowments. Where a group of trained investigators can be gathered together under one roof, the output of a laboratory ought to be much greater than where the same individuals work independently in different places. The danger of accumulating, by the scholarship method, a group of *dilettanti* is not a serious one, provided the choice of men for the positions is relegated to the active pathologist in charge.

LEWELLYS F. BARKER.

A Laboratory Manual of Physiological Chemistry. By E. W. ROCKWOOD, B. S., M. D. (Philadelphia: F. A. Davis Co., 1899.)

Instructors in physiological chemistry have long felt the need of an English manual which will contain clear and accurate descriptions of well-selected experiments, noting the precautions that must be observed in order that the experiments may be brought to a successful conclusion, and giving at the same time a sufficient amount of descriptive material to make the object of each experiment intelligible.

This little book, which might more properly be termed an elementary manual, certainly fulfills these conditions. The material is printed in two kinds of type, so that it is optional with the instructor whether the course be made one of moderate duration or a somewhat shorter one. The student is introduced to chemical

processes which are more or less confined to physiological chemical work, by an introductory series of experiments on the three great classes of organic foods; then follow brief chapters on the various tissues and fluids of the animal body. Cuts of microscopic preparations, tables for the preparation of re-agents, and a rather poor spectroscopic chart are also given.

The manual however is not above serious criticism. The whole modern science of physical chemistry is simply ignored, and the author believes that urinary indican is formed somewhere in the body by the union of potassium and sulphuric acid with indoxyl. In spite of these and numerous other short-comings which could be cited, we believe the book to be, on the whole, worthy of recommendation as an experimental guide.

The Cranial and First Spinal Nerves of Menidia. A Contribution upon the Nerve Components of the Bony Fishes. By C. JUDSON HERRICK, Associate in Comparative Neurology, Pathological Institute of the New York State Hospitals. pp. 1-299, with seven plates and several illustrations in the text. (*Utica: State Hospitals' Press*, 1899.)

If one looks over the contributions to neurology, which have been made by American investigators in recent years, he is struck by the fact that a large proportion of these refer to the comparative anatomy of the nervous system. This is doubtless due, in the first place, to the high standards which have been set in biological work in this country; and secondly, to the fact that, of the large number of investigators trained in biological laboratories, several of the best men have been attracted toward neurological problems. While it may be true, that many of the studies in comparative neurology have appeared to have but little bearing upon more distinctly medical problems, medical neurologists have, of late, come to appreciate the marked advantages derivable from a view of the human nervous system from the standpoint of comparative anatomy. The studies upon the phylogeny of the cerebral cortex, and upon the primary and secondary visual and auditory centres need only be mentioned in order to recall to mind the new light upon the structure and functions of the human nervous system, which is attributable to such studies.

The investigations of O. S. Strong, upon the cerebral nerves of the amphibia, inaugurated a new series of researches, the results of which promise to be of very high importance also for human neurology. The application of the doctrine of nerve components to the cerebral nerves followed naturally upon the "four-root theory" earlier formulated for the spinal nerves. Strong's researches on the tadpole established, for the first time in the same type, both the central and the peripheral relations of the sensory components of the cerebral nerves. Since his studies, a number of students have undertaken similar problems connected with other types. The extreme diversity in structure met with among the various groups of fishes makes them particularly suitable for the continuation of such researches, and a number of investigators are at present directing their attention in large part toward the study of the morphological variations met with in these animals.

The work before us represents a most elaborate contribution to our knowledge of this particular subject, dealing as it does with the nerve components in *Menidia*, the ordinary species called "silver-sides," so abundant in shallow water near Woods Holl, Massachusetts. Dr. Herrick, after an introductory section, discusses the lateral-line canals and their organs, the central relations of the cranial components, the spinal nerves, the nerves of the vagus group, the auditory nerve, the trigemino-facial complex, the sympathetic nervous system, the eye-muscle nerves, the optic nerve and the olfactory nerve and nasal organ. Space will not permit us to enter into a description of his findings or discussion of his results. It will suffice to call the attention of neurologists to this very valuable research. It must be read by

every worker who wishes to be familiar with the newer studies in the domain with which it deals. Dr. Herrick's section XII, devoted to certain general considerations, makes especially interesting reading. In his section XIII, he has epitomized his results, and if one has not the time to master the whole article, he can find in this chapter, succinctly recapitulated, the principal points of the paper. To the reviewer it seems a matter of very high interest, that the comparative anatomists have been able to isolate so perfectly the various components of the cerebral nerves. The solutions of many of the problems, as worked out in these lower forms, can scarcely fail to be of great help in the clearing up of certain very complex problems which now puzzle the human anatomist, especially in connection with the rhombencephalon.

L. F. B.

Recollections of a Rebel Surgeon (and other sketches), or, **In the Doctor's Happy Days.** By F. E. DANIEL, M. D. Illustrated. (*Austin*, 1899.)

This little book comes to us from the *Texas Medical Journal*, and contains a number of sketches which have appeared in that Journal during the past year. They are often humorous; sometimes pathetic; and at all times interesting. They are especially of value, as giving a picture of the state of things in the Southern Confederacy during the Civil War, and as such must always be read with interest. The humor is sometimes a little coarse; sometimes far-fetched, but the general effect of the book is pleasant, and one who has started to read it is likely to continue to the end.

Proceedings of the New York Pathological Society, 1897-1898.

Besides containing the pathological descriptions of a very large number of anatomical specimens brought before the society, this volume is also enriched by a long and valuable paper by W. T. Sedgwick, "On the Establishment and Conservation of Purity in Public Water Supplies." A great variety of subjects were presented for consideration to the society, and there are many interesting discussions on abnormal hearts, livers, lungs, kidneys, etc. There is an index to the volume, so that it is easy to look up any subject in which one may be interested; but the index should be better arranged—it is needlessly complex, with double references.

The Modern Treatment of Wounds. By JOHN C. SUMMERS, Jr., M. D. (*Omaha: Medical Publishing Company*, 1899.)

It is a pleasure to come across a small work of this kind, which can be highly praised and recommended. The treatment of surgeons varies like that of doctors, but this is a work which can safely be put into the hands of any young surgeon, and it will do many an older surgeon good to read this book. It is supplied with a good index, and with a few illustrations, some of which might have been better chosen, but it is the text which is essential, and this deserves commendation. There is one point on which we believe the author is somewhat too progressive in his surgery, and that is in the treatment of perforating wounds of the orbit, and skull as a whole. Somewhat more conservatism in the treatment of such wounds seems to us advisable. We note also that he says nothing of the value of prolonged baths in the treatment of severe wounds of large surfaces of the body, and it appears to us also that the strength of the solutions of bichloride of mercury, which he uses for burns, is too high. That the book, however, will be found most useful by many practitioners, we have no doubt.

Love and its Affinities. By GEORGE F. BUTLER, M. D. (*Chicago: G. P. Engelhard & Co.*, 1899.)

Under this somewhat illusive title, the author attempts to make clear in a short treatise the psychology and binding links of lust, love, and religion. The thesis shows a wide reading of both ancient

and modern authors, especially the poets; but while it will do no one any harm to read this little work, it is doubtful whether after having read it, he will find himself any the wiser. That this triune is intimately bound together, none will attempt to deny, but like so many other problems in psychology and philosophy, the explanation of this unity seems to lie outside the power of words to express. We understand their association, but no one can explain love, any more than he can explain any other pure mental or physical quality; for the mind and body, are so intimately connected, that it is almost impossible to separate one from the other. However, the author has treated his subject delicately, and deserves praise for this, for it is difficult to treat lust and love in the same category, for the ideal passion is much more intangible and inexpressible than the physical.

Hints on Elementary Physiology. By FLORENCE HAIG-BROWN. (Philadelphia: P. Blakiston, Son & Co., 1897.)

This is an excellent little primer for nurses; and the introduction, by Dr. William M. Ord, is a recognition of its merit. He says: "As an evidence of earnest diligence in preparation for what is one of the most responsible and certainly the very hardest possible occupation in life (nursing), it calls for all praise and respect. The qualities of the book will, I am well assured, command the success which I most heartily wish for it." It is abundantly illustrated, and the plates are for the most part good, but some should be changed in a second edition, especially that one illustrating the mucous surface of the ileum, on page 79. We do not desire to be hypercritical, but on page 101 the author states that the tongue "is composed of muscle, fat, the hyoid bone, and the lingual vessels and nerves." In such an elementary treatise as this, is it not a little misleading to consider the hyoid bone as a portion of the tongue? Under the title of ventilation, we find the temperatures, given as suitable for dwelling rooms, surgical and medical wards, etc., very low—much lower than is the custom here in America to keep such rooms, and we believe too low for health in many cases. This little book is, in spite of any small deficiencies, far superior to many larger works on this subject written for nurses, and it is to be hoped it may have a wide circulation.

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NOTES ON AN IMPROVED METHOD OF REMOVING THE CANCEROUS UTERUS BY THE VAGINA.

BY HOWARD A. KELLY, M. D., *Gynecologist-in-Chief, the Johns Hopkins Hospital.*

My ideas upon the subject of the extirpation of the cancerous uterus (cervical cancer) have undergone considerable change within the past year. A careful examination of my material and reports from other clinics have shown that we are not reason too closely upon a supposed analogy between cancer of the uterus and cancer of the breast; in other words, glandular metastases, which play such an important part in the extension of mammary cancer are relatively unimportant, and as a rule, only observed in the latest stages of uterine cancer.

More careful histological studies show that the uterine cancer extends progressively through the tissues from its cervical focus. The great aim of the operation for the extirpation of cancer, becomes, therefore, that of giving the diseased cervix the widest possible berth, instead of being, as before supposed, the removal of the uterus plus the extirpation of the pelvic glands.

In the first place the frequent recurrence of the disease in the scar tissue of the vaginal vault points to the importance of commencing the enucleation on the vaginal side at a point far below the manifest limits of the invasion, not less than 2½ cm. distant or even more.

In order to give the diseased cervix the widest possible berth in the direction outwards into the bases of the broad ligaments, I would again insist upon the necessity of catheterizing the ureters in every case as a preliminary to the radical operation. This can be done by putting the patient in the knee-breast position, and introducing my open vesical speculum, and carrying one of my renal catheters up into one kidney and then catheterizing the other. The patient is then turned on her back and the air allowed to escape from the bladder through a vesical catheter, and the enucleation proceeded with.

If this preliminary catheterization is not done, the operator is forced to adopt one of two courses, both of which are bad; either he must skin out the cervix for fear of including the ureters in his ligatures, or he must consume a long time in a difficult dissection of the ureters not marked out by the bougie. The latter alternative many feeble patients will not stand. I insist, therefore, with the utmost earnestness and emphasis that the surgeon who proposes to give his patient the best possible chance of recovery is under the absolute necessity of learning to catheterize the ureters.

After this most important preliminary and after a thorough

curettage of the diseased area, I cut through the vagina on all sides and proceed to strip it loose from the bladder, so as to expose the vesico-uterine peritoneum, and to open the peritoneum as widely as possible at this point. If the bladder is diseased, the base of it may be cut off and left sticking to the cervix.

The peritoneum is now also opened posteriorly into the recto-uterine pouch so that the uterus remains attached by its broad ligaments alone.

A gauze pack is then put into the pelvis behind the uterus and the cervix is thrust back against it, while the anterior uterine wall is caught with museau forceps step by step and drawn down through the anterior incision until the fundus appears at the vaginal outlet.

The next step now is to bisect the uterus from above downward; this is not attended with any serious bleeding.

The surgeon now proceeds to remove the uterus in the following manner: one half of the body of the uterus is caught by a stout museau forceps, while the other half is allowed to retract within the vagina; then, catching the cervix of the same side with the forceps, the body is completely severed from the cervix by dividing from within outward. As soon as the division is completed, the uterine vessels are clamped in the exposed cellular tissue, and the detached body is now pulled further out and the round ligament clamped, and lastly the uterine cornu. In this way one quadrant of the uterus is removed. The body of the uterus on the opposite side is next removed in like manner.

Ligatures are then applied in place of the clamps. The ovaries and tubes are removed after the body of the uterus. It is, as a rule, much easier to remove the ovaries and tubes in this way when there is more room secured than to take them out with the body of the uterus. The removal of the body of the uterus in this way affords so much room that it now becomes an easy matter to take out the cervix on the side which is least implicated, under all circumstances giving it the widest possible berth, and keeping the rigid catheterized ureter under touch all the time during the enucleation.

The steps of the operation as thus far described, which have been rapidly and easily conducted, may be looked upon as more or less preliminary; three-quarters of the uterus have been removed and the remaining quadrant, that half of the cervix which is on the side where the infiltration of the broad ligament is most marked, now remains to be extirpated also, completing the operation.

In reality so important is this last step that the operation may at this point be looked upon as only having just begun. All the skill of the operator must be concentrated upon this step, upon securing the most thorough, wide extirpation of this remaining piece.

In order to do this as effectively as possible, the extirpation of the three portions indicated has afforded a maximum space, and the operator is not now embarrassed by the presence of the uterine body in the pelvis. He holds in the grasp of his forceps a small nodule, one-half of the cervix, and his desire is to get it out with perfect control of the vessels giving it the widest possible berth. This may be done in some cases by ligature, but will be better done in other cases by cautery clamps such as have been devised by Dr. Skene, of Brooklyn or by igniextirpation as extensively practised by Mackenrodt of Berlin (see Martin's Festschrift, 1895, p. 100).

If the ureter lies clearly beyond the diseased area and is unaffected, it may be dissected out and left intact; in many of these cases, however, the operator must not hesitate a moment in cutting off the ureter above the diseased area, and proceeding with the wide enucleation of the nodule as if the ureter did not exist. After the enucleation is over, the ureter may then be readily turned into the denuded bladder and stitched there (uretero-cysto-neostomy).

The anterior and posterior peritoneal surfaces are then drawn down and attached to the vagina, and are again sutured together in the middle line, so as to leave but two small openings up into the pelvis which are loosely stuffed with gauze.

While the cases operated upon are still too recent to be offered in evidence, there can be no doubt whatever that this plan of operating, like any other plan which gives the diseased a wider berth, must give a better percentage of permanent recoveries.

CASES:	F. J., Nov. 7, 1899,	Gyn. No. 7351.
	S. S., Nov. 14, 1899,	" 7370.
	E. J., Nov. 14, 1899,	" 7371.
	S. T., Nov. 18, 1899,	" 7384.
	E. M., Nov. 29, 1899,	" 7405.
	K. H., Nov. 30, 1899,	" 7411.
	M. J., Dec. 21, 1899,	" 7428.
	M. H., Jan. 10, 1900,	" 7495.
	I. B., Feb. 24, 1900,	" 7582.

A PRELIMINARY REPORT ON THE SURGICAL TREATMENT OF COMPLICATED FIBROID TUMOR OF THE WOMB, WITH A DESCRIPTION OF TWO METHODS OF OPERATING.

BY HOWARD A. KELLY, M. D., *Gynecologist-in-Chief, the Johns Hopkins Hospital.*

It is now four years and a half since I described before the Southern Gynecological Association, at a meeting in Washington, November 12, 1895, a new method of performing a supravaginal myomectomy for fibroid tumors of the uterus.*

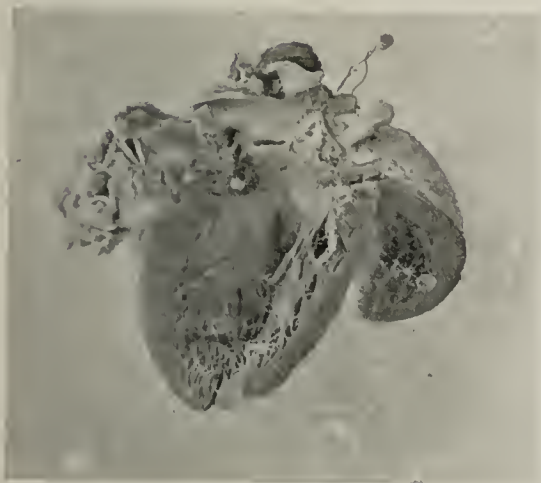
This new method of enucleation was by means of a continuous incision through first the ovarian, then the uterine vessels of one side, down under the tumor, cutting across the cervix, and catching the uterine vessels of the opposite side as they are exposed, and up the broad ligament to the round ligament, and last of all the corresponding ovarian vessel. By means of this rapid plan of enucleation the tumor and

* See BULLETIN of the Johns Hopkins Hospital, Feb., 1896.



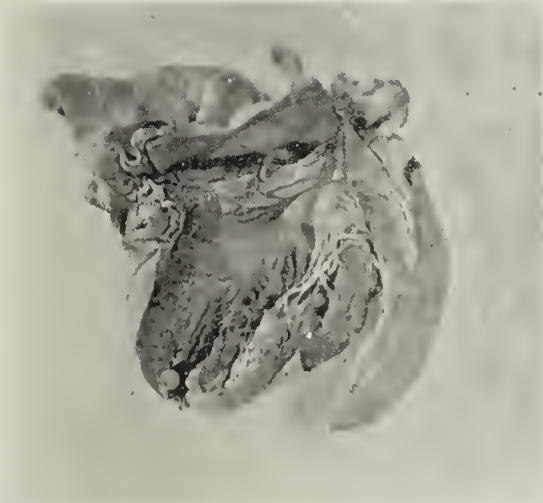
THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 1.



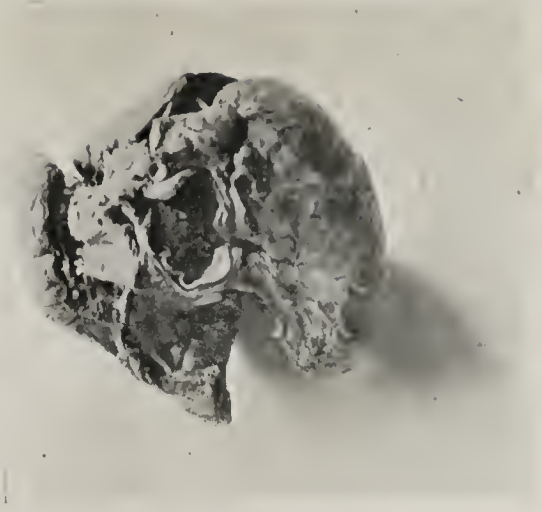
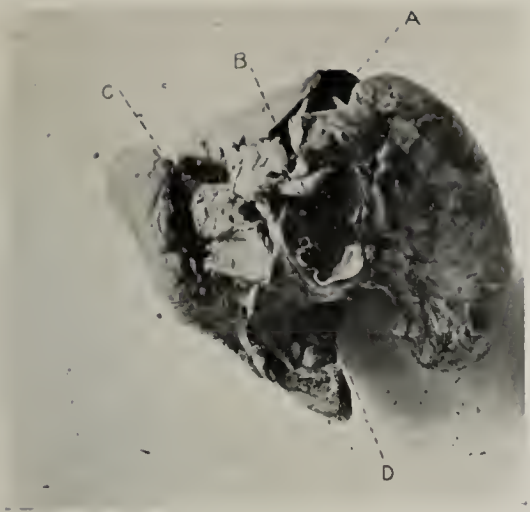
THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 2.



THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 3.



THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 4.



THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 5.



THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 6.



THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 7.



THE JOHNS HOPKINS HOSPITAL BULLETIN, MARCH, 1900.

PLATE IV, FIG. 8.

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The figures of Plate IV have been arranged separately as they are designed for use in the stereoscope.

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AND
ZOOLOGY
OF THE
CITY OF LONDON

the part of the uterus involved with it are rolled out and all the vessels controlled within three or four minutes.

Complications on the part of the tubes and ovaries, in the form of adhesions, hydrosalpinx and pelvic abscesses, are also more easily dealt with under this plan of enucleation than under any other. It is always easier to attack an inflamed tube and an ovary from the front of the broad ligament which is opened up in this way, than to attack the same inflamed structure from the posterior part of the pelvis before enucleating the tumor.

The large experience which I have gained since publishing the paper above referred to has only served to confirm my conviction that no other plan of operating can rival this one in simplicity, in rapidity, and in affording complete control of the complications referred to.

While this plan is the best for the vast majority of cases, occasionally a complicated case turns up in which it can only be applied with difficulty. I have in mind several cases which have recently passed through my hands where neither the common method of performing hysteromyomectomy, that of tying down on both sides to and including the uterine vessels, and then amputating the cervix, nor my own method of the continuous transverse incision epitomized above was applicable without great difficulty and considerable risk to the patient.

The first case in which I found it necessary to make a radical departure in the method of enucleation belonged to the group of cervical myomata. In this instance there was no cervix to be felt by the vagina, and on opening the abdomen the bladder was found raised half way up the umbilicus by an ovoid tumor choking the pelvis, with its long axis vertical. The body of the uterus containing a few small nodules sat high up in the abdomen above the umbilicus like a cap on top of this tumor and on the right and on the left sides the displaced uterine and ovarian vessels were spread out in a network. I began the enucleation by trying to tie off these vessels wherever I could catch them on the left side. There was a great deal of hemorrhage from the surface of the tumor, and as soon as I commenced to detach the ligated vessels and to push them down the hemorrhage increased. It was evident that the patient, who was already feeble and anæmic, could not survive the operation if there was to be any additional considerable loss of blood. I then at once resorted to the following plan which promptly overcame the difficulty and speedily terminated the operation without further loss of blood:

I took two long-jawed pedicle forceps and controlled all the vessels on each side of the uterus on top of the tumor by thrusting one of the open jaws of the forceps through the capsule of the tumor on one side at about the level of the round ligament from the front of the broad ligament until the point appeared on the posterior surface of the tumor behind the broad ligament; I then clamped the forceps powerfully down on the uterine and ovarian vessels, entirely controlling the circulation. Both sides were treated in this way.

I then took a long-bladed knife, and grasping each uterine cornu with stout short-toothed museau forceps and pulling

in opposite directions, I bisected the uterus and cut on down into the tumor as far as the vesical peritoneum, which was freed and pushed down, when the tumor was completely bisected.

The next steps were the enucleation of the left and the right halves of the tumor. Grasping the left half of the tumor at a convenient point and pulling it away from its bed with a pair of museau forceps it was rapidly enucleated from its uterine bed by means of a blunt crenated spatula, which I always use in the enucleation of myomata. The right half was then enucleated in the same way. All these steps were carried out without a particle of hemorrhage, in remarkable contrast to the beginning of the operation.

With the enucleation of the large cervical tumor the tissues surrounding it collapsed, and the uterine artery was easily reached and tied at a selected point below the body of the uterus, and all the difficulties of the situation vanished and the case became a simple one. The two halves of the uterus were enucleated separately and the bed of the tumor closed by buried sutures and the vesical peritoneum drawn over and attached to the posterior peritoneum concealing the wound and the operation finished.

The enucleation of the bisected uterine body may be done after the removal of the tumor in one of two ways—either by tying the ovarian vessels, now easily reached, and the round ligaments and lastly the uterine vessels and then amputating, or by severing first one then the other half of the uterus from the cervix below, cutting from within outwards, from the centre of the cervix towards the broad ligament, and so exposing and catching the uterine vessels, after which they are divided and each half is pulled up in turn by its cervical extremity and the round ligaments of the ovarian vessels tied in order. The direction of the enucleation in this case is from below up, the reverse of the direction ordinarily taken; the extirpation in this way is facilitated by the sagittal bisection of the uterus.

The patient made an excellent, uninterrupted recovery, and has returned to her home and duties in the country.

I would urge this plan of dealing with fibroid tumors of large size occupying the lower uterine segment, and elevating the uterine as well as the ovarian vessels, and choking the pelvis; in these cases the vessels cannot be tied in mass, but require numerous separate ligatures, and the operator is constantly embarrassed by hemorrhage if the ordinary plan is pursued.

The other case in which still a different plan of operating was found necessary was that of a fibroid tumor filling the pelvis and reaching as high as the umbilicus. The patient, when put on the table, had a rapid small pulse which speedily ran up to 140.

I opened the abdomen, and after releasing some omental adhesions, found the large tumor firmly fixed in front of the vertebral column behind the umbilicus by extensive dense adhesions. The colon was so intimately attached to it that it soon became evident as I tried to detach it that a continued dissection would necessitate an extensive resection of the bowel. I then resorted to a plan successfully adopted in a previous case, January 24, 1891 (See Gyn. Reports, No. 2, p.

582), that of leaving a thin layer of the tumor upon the bowel, that is, of sacrificing the tumor for the sake of the bowel. As soon, however, as I cut into the tumor it began to bleed freely, and I did not dare to go ahead on account of the condition of the patient.

I then turned to the lower pelvic pole of the tumor, hoping to be able to free it by tying off the vessels from above downwards and amputating the cervix; I found it attached to the whole anterior surface of the uterus above the cervix, pushing the fundus of the uterus down to the pelvic floor out of reach. I was able to place two clamps on the tops of the broad ligaments controlling the ovarian vessels, but this was not a necessary step in the following procedure then adopted, which met the complications in a satisfactory manner.

The cervix which could be felt at the vesical reflection was caught by stout short-toothed museum forceps and pulled up within reach; the vesical peritoneum was detached and pulled down, exposing more of the cervix, which was caught with a second pair of forceps.

A knife was then plunged through the cervix in an antero-posterior direction between the two pairs of forceps, and the cervix was cautiously divided from side to side (that is to say coronally or transversely) by pulling the divided cervix apart. The cellular tissue to the left of the cervix was first exposed, and the uterine vessels, not yet seen, clamped with a short, stout forceps; the uterine vessels on the right side were next controlled in the same way.

When these important vascular trunks were thus secured, the upper forceps was forcibly used to drag up the tumor and uterine body, rotating them on a transverse axis, exposing first the round ligaments and then the ovarian vessels of the left and the right sides, respectively; these structures were clamped and the whole mass disconnected from its pelvic attachments. The tumor now only remained adherent by the dense adhesions at its upper pole. The next step was the rupture of an enormous abscess lying behind it and extending from the centre of the tumor into a sac bordered posteriorly

by the lumbar vertebræ and above by the mesocolon and discharging through a large opening into the transverse colon. The tumor now rolled out, being enucleated from behind forward without added injury of the bowel, other than was rendered necessary by the opening into its lumen. The contaminated abdominal cavity and the abscess cavity, containing at least a litre of thick yellow pus, were cleansed, the opening in the bowel sutured and the long abdominal wound closed leaving a large iodoform gauze drain about the umbilicus in the remainder of the sac under the colon.

The patient has made an excellent recovery with a small rapidly closing fistulous tract.

This type of operation is, I think, the very best that can be adopted for those cases in which there are dense adhesions to the upper pole of the tumor which cannot be dealt with without great risk by attacking them in a direction from before backwards.

I have tried the first plan of operating by bisecting the fibroid uterus in eight cases in all; it has so happened that several complicated cases of tumor developed in the cervicovaginal region have recently come into my hands. In the other cases I simply made the enucleation in this fashion in order to demonstrate its feasibility. The continuous transverse incision must always remain the operation of elective choice.

The second plan of operation has been followed in but one case (K. H.).

CASES: A. W., December 10, 1899, No. 7438.

C. W., December 21, 1899, No. 7460.

T. B., January 1, 1900, No. 7474.

A. S., January 3, 1900. (Sanatorium.)

M. B., January 27, 1900, No. 7537.

D. C., February 4, 1900, No. 7552.

E. H., February 24, 1900, No. 7583.

M. K., February 26, 1900, No. 7597.

K. H., February 1, 1900, No. 7549. (Myoma with abscess opening into colon.)

OBSERVATIONS UPON THE NEURAL ANATOMY OF THE INGUINAL REGION RELATIVE TO THE PERFORMANCE OF HERNIOTOMY UNDER LOCAL ANÆSTHESIA.*

BY HARVEY CUSHING, M. D., *Associate in Surgery, the Johns Hopkins University.*

INTRODUCTION.

During the past two years in a considerable percentage of the large number of herniotomies performed in Dr. Halsted's clinic recourse has been made to methods of local anæsthesia. In thirty of these cases definite contraindications to the employment of general narcosis have been present, and from this number two definite groups may be recognized:

(I) Those cases in which immediate operative intervention is demanded, as in strangulation, and in which ether is contraindicated from the shock and vomiting associated with ileus;

And (II) the cases in individuals advanced in years who desire to become rid of an annoying hernia, and who a few

years ago were uniformly refused operation, since associated cardiovascular lesions, chronic bronchitis and emphysema with other senile changes made them submit to the administration of general anæsthesia with notorious uncertainty.

When there exists no apparent contraindication to the administration of ether or chloroform, however, it may safely be said that the anæsthesia of the operator's choice will continue to be a general and not a local one. Nevertheless, during the past few months observations upon the neurovascular anatomy of the inguinal region to be reviewed in this paper have so greatly assisted us in the development of a painless operation that this statement may be qualified to a considerable degree. Since August of 1899 thirty-two herniotomies with cocaine or eucaine β have been performed upon young

* Extracted from *The Annals of Surgery*, Vol. XXXI, 1900, p. 1.

men who might without risk have taken a general anæsthetic, and in many instances absolutely without the infliction of pain other than that incidental to the first insertion of the needle. During the fall this procedure became so popularized in the ward where our hernia cases were admitted that the operation under the local anæsthetic became the method of the patient's choice. An individual awaiting operation needed to remain in the ward only long enough to compare the convalescence of an ether case with that of one done under cocaine to choose the latter for himself. Such patients usually regard the shaving and skin preparation as the most trying part of their operative ordeal, and most of the original observations on cutaneous anæsthesia were made on these cases during the operation and immediately after closing the wound. It has been found also that the patient can assist not a little in certain steps of the operation, as, for example, when the neck of the sac is closed, in making negative abdominal pressure to prevent the omentum, or bowel, from being pushed down between the peritoneal sutures.

OBSERVATIONS FROM COCAINE OPERATIONS UPON THE NEURAL ANATOMY OF THE HERNIAL REGION.

The application of an anatomical familiarity with the peripheral distribution of the spinal nerves, which since the introduction of ether and chloroform has fallen into abeyance, has become once more of interest and importance to the surgeon in extensive operations under local anæsthesia. Furthermore, no condition has ever afforded similar opportunities for the accurate investigation of the sensory distribution of these nerves, since methods of dissection are necessarily gross, and physiological experiments upon animals naturally present variations from the human type.

The principles of cocainization of main trunks of nerves, introduced as early as 1885, have since been utilized in operations on the extremities for minor and even major amputations,* for the anæsthetization of areas on the thigh preliminary to the removal of Thiersch grafts and like procedures, but I am unaware that heretofore similar methods have been made use of in operations on the trunk. To insure success in any major operation attempted under local anæsthesia, an accurate knowledge of the course and situation of the nerves likely to be encountered is most essential, since the accidental division of an unexpected sensory nerve-trunk is often sufficient to overcome whatever preliminary inhibition to pain the patient may have had, and thus to make recourse to complete narcosis necessary in cases where it should, perhaps, be specially avoided. In our earlier hernia operations pain was not infrequently inflicted where now none is occasioned, owing to greater familiarity with the course and distribution of the nerves concerned.

*Absolutely painless amputations of the lower extremity for senile gangrene in individuals to whom it seemed unwise to administer ether have on two recent occasions been performed at this hospital after preliminary exposure and cocainization of the sciatic nerve in the thigh (under cocaine). This procedure is free from the objections which seem to attend Bier's method (*Deutsche Zeitschrift für Chirurgie*, 1899) of cocainization of the spinal cord.

In the accompanying sketch (Fig. 1) an attempt has been made to show diagrammatically the usual cutaneous distribution of the inguino-scrotal nerves as well as the deeper situation of the main trunks. Through the kindness of Dr. Bardeen I have been able to compare with my results a great number of sketches made in the anatomical department for an unpublished report on the peripheral nervous system, and though there is considerable variation in the situation and anastomoses of the particular nerves of this region, as may be seen by consulting Griffin's article (*Journal of Anatomy and Physiology*, 1891), we have taken what may represent the average.

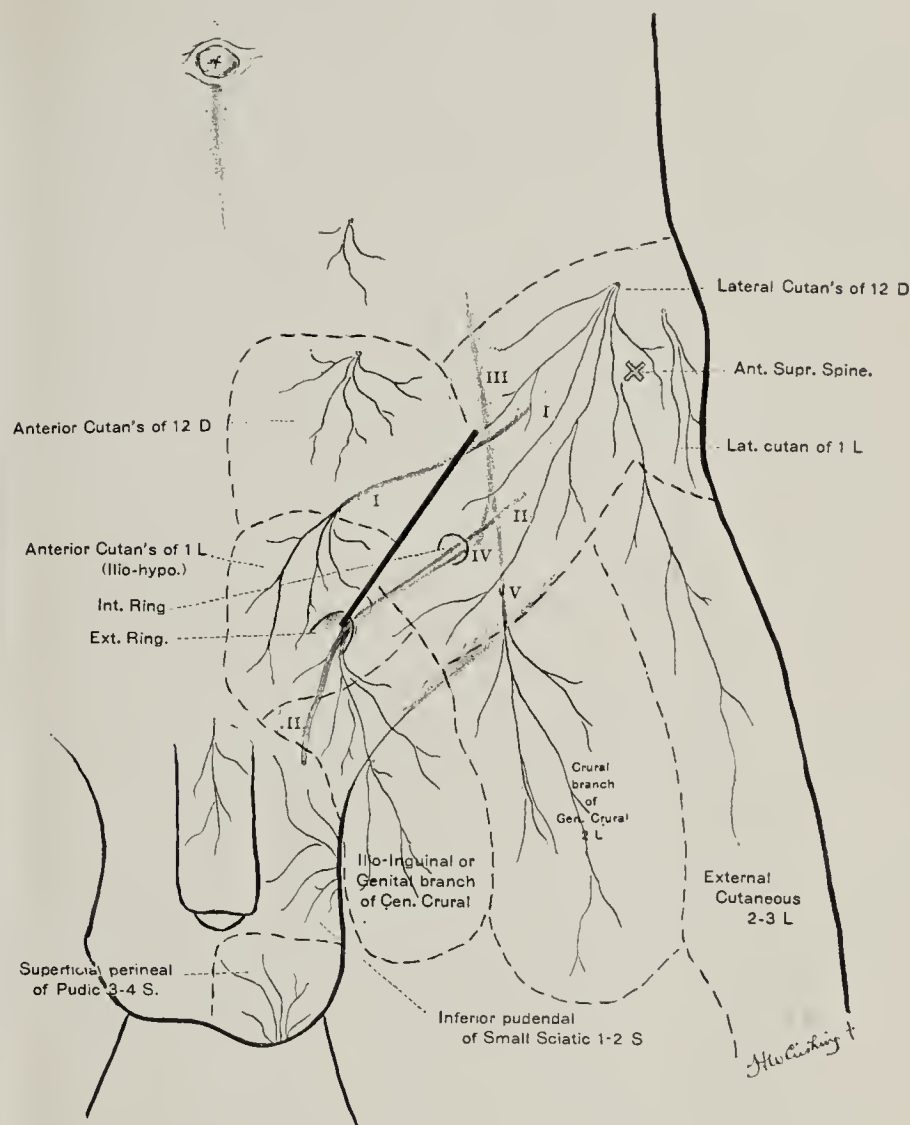


FIG. 1.—Showing inguino-scrotal nerves, their peripheral distribution and relation of the main trunks to the hernia incision. I. Iliohypogastric; II. Ilio-inguinal; III. Genito-crural; IV. Genital branch; V. Crural branch.

Superficial Nerves encountered by the Incision.—The skin incision, as ordinarily made, passes in a line which separates the ventral and lateral cutaneous branches of the twelfth dorsal and first lumbar nerves. The lower angle of the incision, however, quite uniformly overlaps the anterior branches of the first lumbar (ilio-hypogastric) nerve, as they sweep downward and outward from their point of emergence through the aponeurosis, about five centimetres above the external ring. The upper angle of the incision, depending

somewhat on its distance from the median line, and also upon the variable and complementary length of filaments of the



FIG. 2.—Areas of anæsthesia after double cocaine herniotomy. Anæsthesia lies to the inner side of left incision, which was made nearer Poupart's ligament and has divided lateral cutaneous branches of twelfth dorsal. It lies to the outer side of the right incision made farther from Poupart's and dividing fibres from the anterior division of twelfth dorsal. This was one of our earlier cases in which no attempt was made to preserve the nerves, and the anæsthesia is permanent.

ventral and lateral branches of the twelfth thoracic, may divide fibres from one or the other of these sources, and thus lead to a subsequent area of anæsthesia to the inner or outer side of this upper angle of the incision. This is well illustrated by the accompanying photograph (Fig. 2) of a double



FIG. 3.—Showing small post-operative area of anæsthesia to the inner side of the incision, consequent to the division of lateral cutaneous branches of the twelfth dorsal. In this case the ilio-inguinal and genital branch of the genito-crural had been divided with loss of cremasteric reflex, but without producing any cutaneous anæsthesia.

herniotomy, in which the incisions were made at different distances from the median line. This bordering anæsthesia, on one side or other of the skin incision, may occasionally represent the entire area of post-operative cutaneous anæ-

sthesia, even when the ilio-inguinal and the genital branch of the genito-crural have been divided or cocainized, as is shown in photograph (Fig. 3). Presumably in such instances the crural branch of the genito-crural supplies the area on the inner side of the thigh (cf. Fig. 4) usually innervated by the former two nerves. Such an arrangement occurs not infrequently in Dr. Bardeen's diagrams. On several occasions there has been no resulting post-operative area of cutaneous anæsthesia whatever.

Deeper Nerves met in the Operation.—The ilio-inguinal nerve emerges from the external ring, and near by, or also through the ring, the genital branch of the genito-crural appears. In the canal they frequently are found anastomosed as one trunk the early cocainization of which at the deeper part of the canal, after splitting the aponeurosis beyond the internal ring is perhaps the most important step of the operation. As has been stated above, this may result in no additional cutaneous anæsthesia. The usual anæsthetic sequel, however, is represented by a complete loss of sensation of the entire scrotal contents, cord, hernial sac, and testicle, with the possible exception of its lower vascular supply (superficial perineal



FIG. 4.—Area of anæsthesia of ilio-hypogastric, ilio-inguinal, and genital branch of genito-crural in a unilateral cocaine case, following operation. This began to fade by the twenty-first day, with return of cremasteric reflex. This represents the most complete type of anæsthesia in unilateral cases, and is the same even after division of the cord and castration, and consequent section of all possible cutaneous filaments of the genital branch of the genito-crural and the ilio-inguinal.

and by a cutaneous area of anæsthesia which occupies the inner side of Scarpa's triangle, spreading over the adductor tendons. Division of the nerve is unassociated with any surface anæsthesia of the scrotum whatever (cf. Fig. 4). It is ordinarily stated, to the contrary, that these nerves are source of cutaneous supply to the scrotum; for instance Professor Thane says (Quain's "Anatomy," Vol. iii, Pt. I p. 341, 1895), "The root of the penis, on its dorsal aspect, and part of the scrotum anteriorly are supplied by the ilio-inguinal and genito-crural nerves." It was of extreme interest, consequently, to find that the ilio-inguinal, supplying most of the contents of the scrotum, was not represented by any cutaneous distribution to the same. The inferior pudendal branch of the

small sciatic and superficial perineal of the internal pudic, therefore, supply in most cases, at all events, its entire cutaneous surface. It is possible that, on the principle of Sherrington's observation concerning the overlapping of sensory areas, we might account for the failure of anæsthesia after division of the single nerve to appear over the whole territory innervated by it, but as will be seen by comparing segmental spinal lesions such an explanation will not hold, and probably the whole serotal cutaneous supply is from the sacral and not the lumbar plexus. A case of fracture-dislocation of the spine at

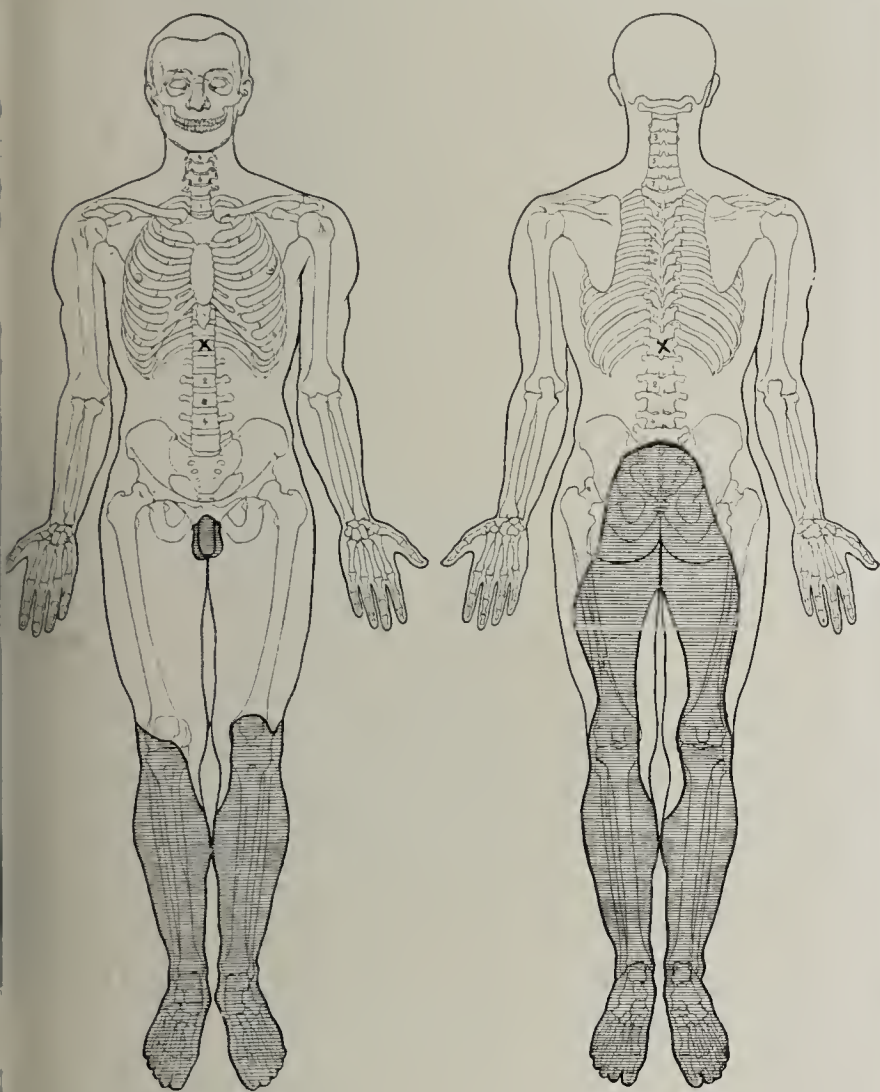


FIG. 5.—Areas of cutaneous anæsthesia result from a compression fracture of the twelfth dorsal vertebra, producing a total transverse lesion at the fifth lumbar segment. Serotal and penile anæsthesia are complete, though the lesion lies below the first lumbar (ilio-inguinal) segmental level.

the twelfth dorsal vertebra, with transverse lesion of the cord, entered the hospital at the time these observations were being made, and offered confirmatory evidence of what has just been stated. The anæsthetic areas resulting from this injury, and which are shown in the accompanying diagrams plotted by Dr. Yates (Fig. 5), offered an interesting negative of the anæsthesia following the hernia cases. Though the entire penis and scrotum in this case were devoid of sensation, the transverse lesion of the cord was situated at the fifth lumbar segment,—that is, between the level of origin of the ilio-inguinal (first lumbar) and that of the small sciatic and

internal pudic (second and third sacral) nerves. If the ilio-inguinal normally overlapped the latter nerves, the root of the penis and upper part of the scrotum would naturally have retained sensation. A similar condition is shown in one of Kocher's diagrams of a case of fracture-dislocation at this level. (*Die Läsionen des Rückenmarks* u. s. v., S. 627). In another of his cases (*Ibid.*, S. 631), in which the segmental lesion is at the 3-4 sacral level, the upper portion of the scrotum has retained sensation as the inferior pudendal (1-2 sacral) has escaped injury.

Furthermore, in this spinal case, as would be expected, the cremasteric reflex was retained, whereas we have observed that after division or cocainization of the ilio-inguinal and genito-crural nerves, this reflex is, temporarily, at all events, lost on the side of division.* On the other hand, the vermicular movements of the dartos, supplied together with the skin by the sacral nerves, are preserved after divisions of the ilio-inguinal, but were lost in the spinal case together with the cutaneous anæsthesia.

The ilio-hypogastric, as will be seen in the diagram (Fig. 1), may be twice encountered in the operation; its superficial filaments by the skin incision, as has been described, and its deeper trunk, as it lies upon the muscle-fibres of the internal oblique at a varying distance from the lower edge of the muscle (Fig. 6). Cocainization of the edge of this muscle, consequently, before its division as in the Halsted operation, is very necessary, especially since, in addition to this main trunk, which may usually be easily recognized after exposure of the internal oblique, there are, contrary to Griffin's observations, off shoots to the muscle itself from this nerve, given off dorsad to the portion exposed by the incision. There are fibres from the genito-crural (Thane) as well, which are similarly distributed to this lower border of the internal oblique. The area of cutaneous anæsthesia, which follows anæsthetization or division of this main stem of the ilio-hypogastric at its point of exposure, surrounds the lower angle of the incision, and extends from a level about seven centimetres above the root of the penis to within one or two centimetres of that organ. No anæsthetic area has ever been found corresponding to Macalister's described branches reaching up towards the umbilicus. In unilateral cases this ilio-hypogastric anæsthesia does not extend to the median line, owing to the overlapping of fibres from the opposite side, so that in bilateral cases alone, such as are illustrated by Fig. 2, can its limits be definitely made out.

THE ANÆSTHETIC, AND APPLICATION OF ANATOMICAL OBSERVATIONS TO THE OPERATION.

It is not within the scope of this paper to discuss the relative merits of various local anæsthetics; suffice it to say that we have found the combination advocated by Schleich ("Schmerzlose Operationen," 1899) to be as efficacious as any with which we have experimented. His solution No. 2, containing the following ingredients:

* It is important, therefore, to guard against division of these nerves in varicocele operations in which it is desirable to preserve cremasteric tone.

Cocainæ mur.,.....0.1
 Morphinae mur.,.....0.02
 Sodii chlor.,.....0.2
 Aqua destillata, ad 100.00

has best served our purpose, and has been without the objections usually accredited to cocaine solutions,—viz., toxicity and dissolution when sterilized. Solutions in strength of 1 to 20,000, Schleich claims to be efficient for infiltration, and capable of producing anæsthesia which is free from the prodromal hyperæsthesia, the “anæsthesia dolorosa,” which accompanies aqueous and saline infiltrations. Amounts of the 1 to 1000 solution, however, greatly in excess of what is needed for the longest operation, have failed to give toxic symptoms, and, contrary to the experience of many, we have found that one or two sterilizations fail to diminish its efficiency. Experience with eucaine β , which Braun (*Archiv für klinische Chirurgie*, 1898) and Hentze (*Archiv für pathologische Anatomie und Physiologie*, 1898) have so strongly advocated, has failed to demonstrate in our hands that it possesses any superiority over the 0.1 per cent cocaine solution of Schleich. In fact, we have been impressed by the fleeting nature of the anæsthesia and by its tardy appearance.

On several occasions long skin incisions have been made through a linear area of anæsthesia, produced half with sterilized Schleich’s solution and half with the eucaine β combination, which Braun advocates. If the operation is prolonged over an hour, pain is occasioned on placing the subcuticular suture of closure in the eucaine area, while none appears in that which had been infiltrated with cocaine. The fact that its toxicity is five times greater than that of eucaine does not argue in its disfavor, provided one uses solutions weak enough to avoid toxic effects. For anæsthetization of the individual nerve-trunks I have used a $\frac{1}{2}$ to 1 per cent sterilized solution usually of cocaine which is injected directly into the nerve sheath.

Steps of the Operation.—Individuals—and it is especially important for those advanced in years—are usually kept in bed for a day or two preliminary to the operation, to give an indication of their ability to endure recumbency and for the purpose of training them to void their urine in this position. Evacuation of the bladder is usually accomplished by the aid of an enema if any postural difficulty is experienced, and it is a matter of satisfaction that but one of the cases reported in which these precautions were taken required post-operative catheterization, an old man, sixty-eight years of age, who had symptoms of prostatic hypertrophy.

It has been the custom to administer hypodermically a tenth or an eighth of a grain of morphine, three-quarters of an hour before, and to repeat this shortly before the operation. Ceci has emphasized the efficiency of this morphia-cocaine combination, and I have found it most satisfactory. The drug must be used with caution, however, since occasionally even small doses of morphine in old people may confine the bowels and lead to distention, which may be troublesome, as one of our cases illustrated. Similarly, in old people with tardy bladders, it may inhibit the proper evacuation of the urine, though we have never had the misfortune to observe this.

Patients past middle age also are usually shaved and cleaned

on the operating-table, to avoid any exposure incidental to an open-ward preparation. The skin in the line of proposed incision is infiltrated with Schleich’s cocaine solution, and the incision may be immediately made through the linear wheal thus produced. It is common experience to find the infiltrated tissues more vascular than usual, and it is important that all bleeding points be immediately clamped, since a dry and unstained field is essential to the success of the dissection.*

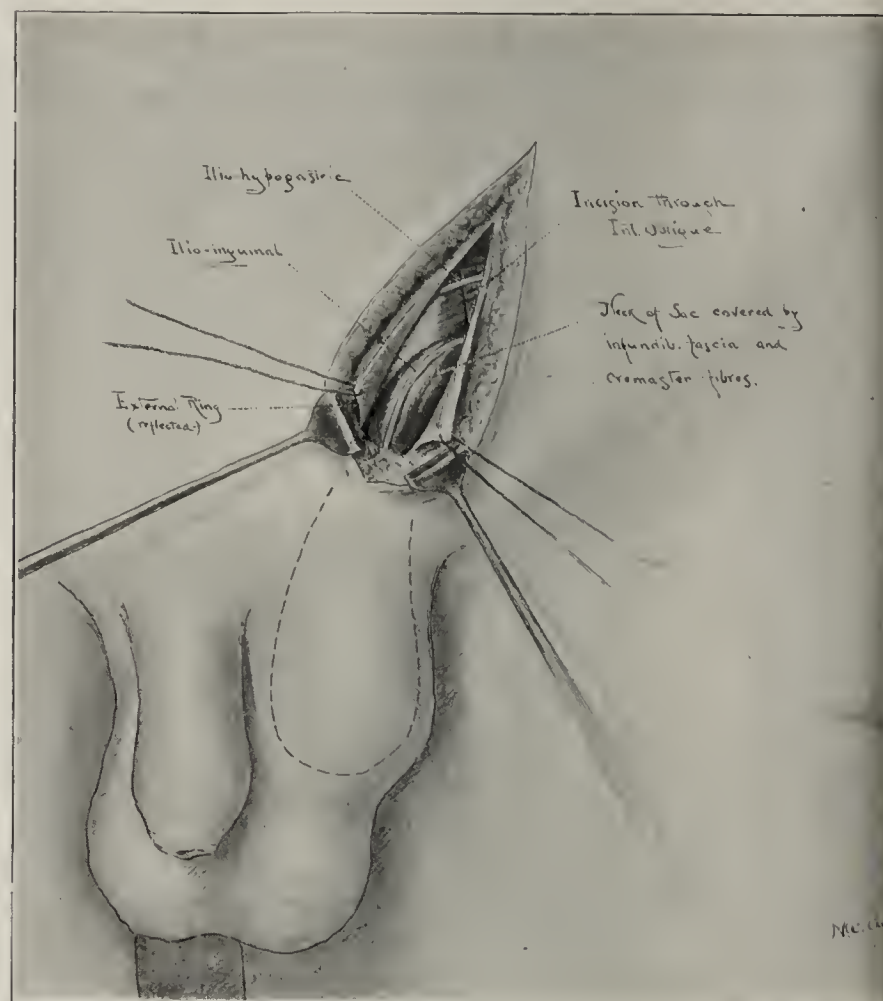


FIG. 6.—Sketch showing usual situation of nerves as exposed after reflection of the divided aponeurosis.

It is unnecessary and useless to attempt to anæsthetize the panniculus. As Schleich has shown, only tissues which can be “œdematized” are fitted for the infiltration method, and in the panniculus, at the upper angle of incision practically no nerves are encountered. If, however, throughout its whole length, this incision is carried down to the aponeurosis, unanæsthetized fibres of the ilio-hypogastric will be encountered in the superficial fat at the lower angle, together with one or two large veins, division of which is painful, so that anæsthetization of the panniculus layer would here be necessary. A much better method is to carry the incision only at

* A good index of one’s skill and familiarity with the hernia operation can be drawn from the condition of the tissues at the time of closure, for they should be as free from blood-staining as when first incised. This, of course, is the most important factor in obtaining perfect healing, and for the accomplishment of this a good assistant is indispensable. A perfect hernia operation is not a “one-man” operation.

the upper angle down to the aponeurosis, which is then opened by a line of fibres from the external ring, and the ilio-hypogastric and inguinal nerves immediately cocainized with a 1 per cent solution as they are thus exposed. After this procedure the lower angle of the incision may be painlessly carried down to the external ring, and the remaining intercolumnar fibres of the aponeurotic insertion divided. Reflection of the pillars of the ring then gives the view shown in the accompanying sketch (Fig. 6). In the Halsted operation at this stage the external oblique fibres are divided, preliminary cocainization of the edge of muscle being necessary for the reasons given above. There is, under ordinary circumstances, no further need of the anæsthetic, as we are working in an area freed from all sensation. The combined ilio-inguinal and genital branch, which has been cocainized at the outer limit of exposure, is now reflected usually to the outer side, care being taken not to divide it, since this leads apparently to a more or less permanent paralysis of the cremaster, which is to be avoided. I believe the accidental division of this nerve leads to the great relaxation of the scrotum so often seen after hernia and varicocele operations. In the latter operation, especially, it would be detrimental to the best interests of a successful result to interfere with the cremasteric function in any way. I think it not impossible also that the division of these nerves and interference with the sympathetic plexus about the cord may be responsible for the occasional atrophy of the testicle which has followed the great denudation of the vas deferens in some operations. The remainder of the operation, the exposure of the sac and cord after a longitudinal division of the infundibuliform fascia, the amputation of the cord at its neck, and closure of the peritoneal opening, the division of the fundus of the sac, division of the cord and castration—if deemed advisable in senile cases—may now be done practically without pain. Occasionally, however, some stray branches of the genito-crural may be encountered about the neck of the sac, and also during castration I have found that ligation of the veins at the lower pole of the testicle may be painful, though division of the cord above is not. Possibly the superficial perineal branches which have been unanæsthetized furnish nerves to this lower blood-supply.

The closure of the parietes by any of the more commonly employed methods may now be painlessly accomplished. Not infrequently in these cases, in old people with large hernias long standing, the two rings have become concentric, and the falciform expansion of the conjoined tendon is no longer present. It is in such cases that Bloodgood has advocated transplantation of the rectus fibres after opening of the sheath and exposure of this muscle, so that a muscle-lined wound may be formed throughout the whole length of the inguinal canal. No additional cocainization is necessary for this step, since innervation of this portion of the rectus comes by the nerves already cocainized. Tightening the deep sutures in closing the wound may elicit a dull sensation of pressure, which the patient usually describes as an uncomfortable sensation of "pressure" and it is occasionally possible that the upper one of the deep sutures must be placed above the level which is completely anæsthetized and thus be painful. For this reason it should be left to the last. The subcuticular

silver suture, used in closing the skin, does not pass beyond the limits of the original area of cutaneous infiltration, and consequently it may be placed without pain. Interrupted "through and through" cutaneous sutures, of course, must be avoided, as they would emerge outside of the limits of original cutaneous infiltration.

It occasionally happens during the operation, whether from slight ability on the patient's part to endure discomfort or from the accidental division of some sensory fibres, that what inhibition towards pain he may have at first possessed becomes exhausted, and recourse must be had to a general anæsthetic. Under these circumstances we have found that a few inhalations of chloroform—not enough, however, to make the patient lose consciousness—are sufficient to tide him over the most difficult parts of the operation. It is remarkable, under such circumstances, how small an amount of the general anæsthetic is requisite to benumb sensation. We may justly speak, therefore, of the method of anæsthesia which is employed as a *morphia-cocaine-chloroform* combination, the first and last drugs being merely adjuvants of the local anæsthetic, which in most cases suffices alone.

An assistant in these cases, who takes the place of the anæsthetist, occupies by no means an unimportant position. The usual record of pulse and respiration is kept, and by occupying his attention and by timely encouragement the patient may be tided over the more trying periods of his operative ordeal; duties which otherwise devolving upon the operator may be distracting. Lilienthal (*Annals of Surgery*, 1898, p. 58) speaks of this position as that of a "moral anæsthetist."

Patients have never complained of post-cocainization pain in the region of the incision, and healing seems to have been absolutely unaffected by the local infiltration. In none of these cases has there been other than primary union. It is very unusual for the large, starched, or plaster dressings, immobilizing thigh and pelvis, to be cut down before the tenth or twelfth day, when the suture is removed.

Advantages of the Local Anæsthetic.—There is an avoidance of unpleasant or dangerous post-etherization sequelæ. There is no vomiting or retching to put strain upon the recent sutures. Urinary disturbances are much less apt to occur, and catheterization is rarely necessary. The diet may practically be continued as before the operation. There is no backache, since there is no narcosis to induce relaxation of spinal muscles, and thus put strain upon the ligaments. The dressings may be applied originally to suit the comfort of the patient—which is of especial importance in old people—and there is no subsequent disarrangement of them. Above all is the advantage gained in being able to operate with comparative safety in patients who would incur immediate risk in submitting to general anæsthesia.

Disadvantages.—These seem trivial in comparison. More time is consumed in the operation, and there is necessarily some distraction to the surgeon. In two exceptional instances there has been some post-operative nausea for a few hours—possibly from an idiosyncrasy toward cocaine. The operation is doubtless more difficult and some pain is inflicted. The degree of this depends entirely, however, upon the surgeon's familiarity

with the use of local anæsthetics in abdominal work, as well as with the steps of the hernia operation and also upon his knowledge of the anatomical distribution of the sensory nerves of the region concerned. On many occasions no actual pain whatever need be experienced, and should there be some, it is small in comparison with the discomforts of an ether convalescence;

and the greater difficulties which confront the surgeon at the operating-table are more than compensated for by his subsequent freedom from the anxiety which, in this particular class of cases, attends the administration of, and convalescence from, general anæsthesia.

THE PATHOLOGICAL FINDINGS IN A CASE OF GENERAL CUTANEOUS AND SENSORY ANÆSTHESIA WITHOUT PSYCHICAL IMPLICATION.

ABSTRACT PAPER.

BY HENRY J. BERKLEY, M. D., *Clinical Professor of Psychiatry.*

The detailed clinical history of this case can be found in *Brain*, Vol. XIV, Part IV, 1891. A careful search of the medical literature has disclosed no similar instance occurring either before or since the date of its publication.

A synopsis of the clinical record as then published shows: (1) A strong hereditary tendency to nervous instability; the mother, two maternal uncles, two brothers and two sisters having been insane. The father had died of tuberculosis. (2) A syphilitic infection acquired from her husband at the age of twenty-nine years, subsequent to which the patient had several abortions, sore throat and falling out of the hair.

For twenty-two years after the subsidence of acute symptoms due to the syphilitic process there was fair health. Then came an attack of acute arthritis, after which the patient never fully recovered her former physical condition. Within a few months thereafter, her eyesight began to grow dim, there were sudden flashes of light before the eyes, and vision was gradually extinguished, only sufficient remaining to enable her to distinguish light from darkness.

In the early summer of 1889, nearly six years after the rheumatic attack, the patient began to experience a general tingling and formication in the skin of the entire body, which was shortly followed by several spells of uncontrollable vomiting.

A consensus of the numerous examinations made during the years 1889 and 1890 showed a total loss of thermic, pain, olfactory, gustatory, equilibrium, pressure and weight sensations; almost total of the visual sense; and a partial loss of tactile and muscular impressions, muscular sense and auditory perceptions. None of the special senses, or cutaneous sensations remained wholly uninvolved.

Besides these disturbances of the sensory apparatus several other symptoms of almost equal prominence were recorded.

The musculature while responding to the will did so in such a feeble manner that the patient was incapacitated from helping herself to any extent. Thus the dynamometer when taken in the hand and squeezed was so feebly compressed that the indicator showed no movement on the dial, though the woman exerted every effort in the trial. Despite this fact, however, both nerves and muscles responded promptly to the galvanic and faradic currents, nor was there anything abnormal noticeable about the quality or time of the reaction.

The cutaneous reflexes were all abolished. The faccial and pharyngeal reflex movements were absent, and a sound could be passed over the epiglottis into the larynx without eliciting a sensation of discomfort or inducing cough. During the attacks of emesis there was no sensation of nausea.

When first examined the knee jerks were present and normal. The biceps jerk could also be elicited with some little trouble. The reaction of the abdominal muscles was lost, and the ankle beat was feeble. By the middle of July 1890, the right knee reflex had disappeared, and the left one was weak. All other reflexes, deep and cutaneous, had been completely abolished. A year later the jerk of the left patella tendon was found to be extinguished.

Furthermore, with auditory perceptions a progressive dulling could be noted. When the woman was first admitted to the hospital, the sense of hearing was fairly acute in both ears. Gradually the difficulty in receiving auditory impressions increased, until finally the voice could not be heard except with strenuous effort.

The ophthalmoscopic examination showed an extensive choroiditis pigmentosa with atrophy of the optic nerve. Only a few vessels could be seen in the retina, and these were of minute size. In both lenses there was a beginning cataract.

Whether the optic nerve atrophy should be considered part of the general disease-process, beginning as it did long before the other symptoms, is somewhat problematical, though in tabes the same trouble is not infrequently noted as a forerunner of definite symptoms of the disease.

The pupils were at first in a state of mid-dilatation, and responded slowly to light, direct or reflected. They did not dilate on irritation of the cervical sympathetic. At a late stage the pupils became somewhat narrower, but remained sluggish to stimuli.

There were a number of interesting disturbances of the glandular secretions. During the fall of 1889 the mouth was found to be almost absolutely dry, the tongue heavily cracked, the epithelium eroded from its tip and sides, while the entire buccal surface was red and congested. At the same time the secretions of the lachrymal glands had almost ceased, the surfaces of the conjunctivæ being dry and injected. The skin was also dry and devoid of odor. After a course of potassium iodide these phenomena slowly abated, and the secretions returned to a more normal state.

Various unusual sensations troubled the patient at times. Cramps of the gastrocnemii, sensations of burning between the scapulæ, a girdle feeling around the abdomen and neuralgic twinges in the nerves of the extremities were often complained of. Occasionally there were clonic fibrillary spasms of the small muscles of the thumbs.

Attacks of diarrhœa, refractory to treatment with drugs, though yielding to a continued milk diet, occurred in the latter part of the winter of 1890. These were on several occasions followed by a protracted vomiting without pain or nausea.

Trophic symptoms in the form of a bulbous appearance of the finger tips and ridging of the nails, together with purpuric spots, developed late in 1891.

Throughout the long course of the illness there was never the slightest departure from normal mentality on the part of the patient; no hysterical attacks, no pathological depression or exaltation, and no delusions or hallucinations were ever noted. A slight apathy was the only perceptible change in the mental phenomena, but this was not greater than is frequently noticed in those who have become blind and helpless.

In discussing the etiology of the sensory phenomena in the previous article, three possibilities were suggested: (1) that the malady was functional, an opinion largely influenced by the pathological findings in the three autopsies on cases of general cutaneous and sensory anæsthesia, reported by Von Niesssen, Krukenberg and Schüppel respectively. This view was held to be hardly consistent with the presence of an optic neuritis, loss of the reflexes and the trophic manifestations; (2) that the case was an obscure instance of syringomyelia; or (3) that the terminal end-apparatus of the peripheral nerve fibres was diseased.

Though many points are not cleared up by the autopsy, and subsequent microscopic examination of the tissues, the results obtained are sufficient to show that none of these explanations would hold good, the nearest approach to a correct diagnosis being found in the last conjecture—disturbance of the peripheral nervous system.

The patient's condition did not materially alter after the record of the case was published. The anæsthetic and other symptoms, from the reports of the House Physicians to the hospital, remained about stationary, and on the rare occasions in which I saw her, there were no additional phenomena to be noted other than a steady though slow decline of the vital powers. Late in the year 1893, another ophthalmoscopic examination was made by Dr. H. Friedenwald, who found in the left eye an extensive and typical retinitis pigmentosa, the pupilla being blurred and of a dirty yellow color. Few vessels could be seen. In the right eye the clouding of the lens was so profound that the retina could not be seen.

About the middle of May, 1898, Mrs. R. became slightly choregic, a condition that slowly increased to coma, in which state she died on the 25th of the month.

The autopsy, performed ten hours after death, was distinctly negative, all portions of the central and peripheral nervous systems showing an apparently natural condition. The larger vessels of the thorax, abdominal and cranial cavities,

showed scattered atheromatous plaques, but were not considerably thickened. The right middle cerebellar and both posterior communicating arteries of the circle of Willis were congenitally rudimentary. There was some gelatinous thickening of the pia over the central regions of the hemispheres. The optic nerves showed but faint signs of a diseased condition, although the left nerve was a little smaller than the right one. Both kidneys were atrophic, weighing 100 grams each, the loss being principally in the cortex.

After proper hardening for the various Nissl, Weigert, Marchi, and other stains, sections of the entire nervous system were made and studied. The results obtained were to a degree remarkable, and for the sake of convenience may be separated into three categories. (1) Lesions appertaining to the blood vessels, (2) those of the proper nerve elements, and (3) those belonging to the membranes surrounding the encephalon and cord.

There being some difference in the intensity of the vascular lesions in the several portions of the nervous system, it is perhaps better to describe the appearances in the several sections in detail. Those of the arteries of the cord being the best defined will be first studied.

The arteries and veins contained in the pia mater are all immensely thickened, but the morbid process varies considerably in its histological characters in different vessels. In the largest arteries, for example, in the arteria spinalis anterior, the intima is approximately normal, while the middle lamina is greatly hypertrophied. In this latter layer the nuclei are too numerous, though few of them correspond in morphological characters to the nuclei of smooth muscle cells. The adventitia shows no alteration either in respect to its nuclei, or to the connective-tissue fibres.

In a few arteries running longitudinally in the cord's envelope the endothelium and fenestrata have separated from the muscularis—probably a post-mortem change—while the latter layer has assumed a coarsely fibrous aspect, and holds but few nuclei of any kind. The fibres making up the former muscular layer are arranged in a convoluted fashion, resembling to some extent the infoldings of a fenestrata, and on a superficial examination the whole layer might be taken for a multiplied membrana elastica. That such is not the case is readily determined by the fact that a perfect lamina is often found internal to the fibrous middle layer.

In a few of the medium-sized arteries, the lumen is completely closed, solely from an overgrowth of the middle layer. The fibrous tissue composing this media shows no evidence of a hyaline degeneration.

The contents of the lumen of such vessels as are not obliterated are interesting. With eosin-hematoxylin or the Van Gieson stain, the whole canal is seen to be filled with a material containing no blood cells, and homogeneous except for a faint granulation. In preparations by other stains, this homogeneous substance is found to contain a few epithelioid cells with round nuclei. Naturally, vessels that are entirely obliterated, or have their lumen filled by a partly organized mass, were in the minority, the greater number having sufficient blood-carrying capacity to perform a portion of their vital functions.

The smaller arteries also present considerable variation in their structural conditions. A majority have walls thickened in the same manner as is present in the larger ones, while with others there is a minor though distinct degree of hyaline degeneration of the middle coat—it now assuming a yellow-brown tint with picric-acid fuchsin. When this hyaline condition is present, the nuclei are sparse and deformed. In a few arteries the elastica is reduplicated, or even quadruplicated, while at the same time the lumen is so narrowed as to be obliterated here and there, or the small opening internal to the intima is filled with a mass of epithelioid cells, in which stainable nuclei are uncommon.

The walls of the larger veins are almost as thick as those of the arteries, but the lumen is dilated rather than narrowed, and often with an irregular outline.

The root fibres of the entire cerebrospinal axis contain numbers of thickened vessels, some patulous, some obliterated. Many of these vessels show a considerable degree of hyaline alteration of the muscularis. Nowhere, however, do the nerve bundles present any considerable augmentation of the connective-tissue elements.

At one point surrounding an artery coursing longitudinally in the meninges, just outside of the external margin of the left Burdach column, lies a nodule of disintegrated round cells, which bears much resemblance to a gummatous neoplasm, which after growing a certain extent had degenerated. The size of this new formation was very small.

The walls of the vessels within the substance of the cord were also greatly thickened, some of those in the anterior horns being visible to the naked eye. Others in the medullated regions are almost equally large. Everywhere there is hypertrophy of the vascular walls, principally of the middle layer and at times it is difficult to distinguish between vein and artery.

The vessels appear to be unduly numerous everywhere; there is no actual new formation of vessels, but the smallest arterioles, even the capillaries, are so thickened as to be unusually prominent in the microscopic field.

This condition of affairs is more especially true for the gray horns than for the medullary tracts. The horns seem to be everywhere strewn with vessels of all sizes, from those noticeable by the unaided eye to enlarged capillaries. The region containing the greatest number of diseased vessels lies lateral, on both sides, to the gray commissure and in Clark's columns.

There was considerable variation in the intensity of the vascular disease in the several regions of the cord and bulb. In the lumbar and cervical levels, while the morbid process was distinct, it had not the same severity as in certain regions of the medulla, and especially in the lower levels of the dorsal cord, where the lesions seemed to have reached their acme of intensity.

The diseased arteries and veins within the nervous tissues have now only one type of alteration. The intima is but slightly affected, a little thickening of the subendothelial tissue being now and then visible, but it is upon the media that the greatest stress of the pathological condition has fallen. This layer is greatly thickened, and presents either a

hyaline or fibrous appearance, according to the intensity and duration of the process, the hyaline degeneration apparently preceding the fibrous change. In some of the vessels the peculiarly shaped nuclei of the muscular structures are to be seen at infrequent intervals, distorted and shrunk to such an extent as to be hardly recognizable. In others no nuclei at all are to be found, and the lamina though fibrous is homogeneous in character. With the Van Gieson stain, the media of a number of vessels takes on a red coloring, but this is diffuse over all the layers, and not confined to the middle one. In still others, the stain acts differently; the intima and adventitia are tinged red, while the muscularis takes only the yellow of the picric acid, and appears not striated but homogeneous.

Externally to the muscularis, lymph spaces are often noted corresponding to local dilatations of the intravascular space. These sometimes contain a few leucocytes. In the adventitia around the altered vessels there is little or no morbid change. It is not unduly thick or fibrous in character, and contains a moderate number of round and oval nuclei. In eosin-haematoxylin preparations a greater degree of intimal involvement is noticeable. There is distinct though slight hypertrophy of the layer, with multiplication to a limited degree of the endothelial cells. The lumina are nowhere closed, though there may be great thickening of the media. The regular ring-like appearance of the lumen is rarely disturbed.

Vascular lesions in the cortex and ganglia of the brain are not nearly so profound as in the cord, though here and there a vessel considerably thickened may be noted, the alteration affecting principally the middle layer.

In the meninges of the encephalon fairly numerous thickened arteries are to be seen. They are not equally distributed everywhere, but occur locally. The points of selection in the basal regions for the most altered vessels are in the nerve roots, and especially in the arteries lying between the nerve bundles. In nearly all of the cranial nerves several of these pathological vessels are to be seen, though it is only rarely that a degenerated nerve fibre is to be discovered near them with the exception of the optic nerve tracts where all the fibres have atrophied.

The arteries of the *integument* showed precisely the same lesions as those of the cord and meninges. In some the morbid process is more extensive than in others, and pronounced hyaline changes in the media are noticeable. The muscular nuclei have for the most part disappeared. The endothelial and subendothelial structures are slightly hypertrophied.

Lesions of the nerve elements varied in direct concordance with the severity of the vascular disease, reaching their acme in the lower portion of the dorsal cord and in the medulla. There was a subsidence of the acuity of the process in the upper region of the cord and in the cortex cerebri. All the changes of a pathological nature were strictly of an atrophic order, and of these the fatty pigmentary degeneration of the cells was the most prominent. Of secondary importance was a condition of simple atrophy of the entire nerve body with shrinkage of the protoplasm and nucleus. The lesions of the conducting fibres were also entirely of a degenerative type.

Throughout the cord, but especially in the dorsal region

many of the cells in the gray horns were completely filled with coarse yellow pigment grains, among which a shrunken nucleus is now and then discernible. No nucleolus is visible in the atrophied vesicles. In rather infrequent instances the nucleus is pushed to the periphery of the cell. The cells of the columns of Clark seem to have suffered more severely than elsewhere.

In those cells in which the accumulation of pigment is not so considerable, the Nissl bodies are coarse, do not retain their regular arrangement in the protoplasm, but are irregularly distributed throughout the substance. At times these granula also show a tendency to group themselves together at the periphery of the cell-body, leaving a clear ring of considerable extent around the neighborhood of the nucleus. In still other nerve bodies there are scattered clumps of granula in the protoplasm, with large spaces in between devoid of any stainable substance. Lying among these better preserved cells are others that are shrunken to a mass of fine granular material in which neither nucleus nor nucleolus is visible.

The state of the nucleus varies considerably in the least damaged cells. In a majority the karyoplasm and chromatin particles are natural, but there are also a variable number in each section in which the vesicle has the appearance of being swollen, and the nuclear substance is unstainable. In a very few instances there is a double nucleolus marking the presence of an irritative process.

In the upper cervical enlargement and medulla the state of the cells was almost precisely similar to that at the lower levels, though a larger proportion shows a normal arrangement of the Nissl methylene blue. In a considerable number the protoplasm is filled with masses of yellow pigment, which sometimes covers and obscures the nucleus. The irregular disposition of the Nissl bodies in some nerve elements is shown with great distinctness, but in others the granula are diffused throughout the cytoplasm, and their ordinary appearance is lost. Quite a number of the nuclei exhibit a shrinkage of their volume and irregularity of contour. The vesicle also has a tendency to retire to the periphery of the protoplasm.

In the medulla, there were cells among the scattered nuclei on the floor of the ventricle that showed displacement and distortion of the cell-nuclei, but pathological cells on the whole are not common, and few of the nuclei of origin of the cranial nerves contain any considerable numbers of them.

In the higher regions of the medulla oblongata the cell-nuclei are much more frequently displaced than lower down, and the bodies of the cells show greater atrophy. In the region lateral to the V-shaped point of the ventricle there are numerous heavily pigmented cells. The entire cytoplasm is now filled with it, and the nucleus is no longer visible. Some of the nerve elements are in process of disintegration, and double nucleoli are by no means infrequent within the nuclear ring. The atrophic process is most marked in the nuclei of origin of the III, XI and XII cranial pairs. Corresponding with the degree of cellular degeneration there is here an advanced degree of arterio-sclerotic disease.

In the anterior portion of the medulla the superior olivary nuclei show a pathological state, in that their cells contain heavy masses of pigment equally diffused through the bodies.

Elsewhere the accumulation of metaplastic material can hardly be said to be greater than is ordinarily found in persons of somewhat advanced age. The Nissl bodies are fairly well stained in such cells as are not considerably pigmented. The cells of the glossopharyngeal nucleus have less pigment in them than any other nerve elements of this region.

At the level of the pons the cells of the nucleus acusticus dorsalis are filled with metaplastic granules; all others are freer from the accumulation of grains than in the medulla. The nuclei in the cells of the acusticus are displaced, and the outlines of the vesicles are indistinct.

Few changes can be determined among the nerve bodies of the cerebellum, and the vascular lesions are correspondingly slight.

In the cortex the quantity of the pigment granules in the pyramidal cells was not above the normal, and is not diffuse but confined to one corner of the cell. The nuclei and nucleoli are perfect. The cells of the corpora striata and lenticular bodies were a little more pigmented than those of the cortex owing to the more extensive vascular implication.

Taking into consideration the severity of the vascular lesions and the degree of pigmentary atrophy of the protoplasm of the nerve bodies consequent thereto, there is singularly little degeneration of the medullated portion of the neurone, and when it does occur, it is only where the vascular disease has reached its maximum of intensity. But two of the cranial nerves showed any varicosity or atrophy of the nerve fibres. The gray degeneration of the optic nerves had apparently long antedated the other lesions, being far more advanced. Few medullated tubes in the tracts showed any blue-black coloring with the Weigert stain, and all were atrophied; yet there was a very trivial thickening of the interstitial connective tissue between the bundles of fibres, and no multiplication of the fixed nuclei. The degeneration of the fibres among the bundles of the hypoglossal nerve was limited to a single strand, and was probably a direct consequence of the occlusion of an artery that ran longitudinally through it.

The examination of the root fibres of the superior portions of the spinal cord was negative. In the dorsal region a greater number than usual of small medullated tubes were discovered, and some of these were blackened by the Marchi stain, but altogether the number was inconsiderable. No varicose fibres were to be seen anywhere.

Within the substance of the cord, two sclerotic tracts, both of small size and among the ascending fasciculi were found. The lumbar cord was free from any trace of medullary degeneration, and it was not until the level of the ninth dorsal vertebra was reached that any disease of the white columns became manifest. At this level, a small area of degenerated fibres first becomes visible, situated in the right column of Burdach in close proximity to that of Goll. The area occupied is very small. It was at first entirely separated from the pia, but soon approached it more closely, and finally touched the margin. The form of the degenerated tract was irregularly pyramidal, the base broad, lying upon the external margin, the apex, sharply defined, penetrating more deeply. Nearly all of the nerve tubes within this area are atrophied,

with here and there an enlarged axis cylinder among them. This degenerated zone disappeared entirely before the cervical enlargement was reached.

A few millimetres above the beginning of the first degenerated tract (at the level of the lowermost border of the seventh dorsal vertebra), a new area of degeneration was noticed, this time in the left postero-lateral column. At first it appears under a magnification of 80 diameters, as a circular patch not larger than the head of a pin, lying close to the Lissauer zone though not within the indirect pyramidal tract, and well separated from the external border of the cord. Very shortly it enlarges, and assumes a wedge-shaped form, having its broad base on the external border of the cord, and its apex turned towards the deeper regions. It now lies well within the direct cerebellar fasciculus.

In the lower cervical region, the sclerotic area broadens, and at the same time moves from the posterior part of the column to a position almost in the middle of the lateral region, now occupying a place along the posterior edge of the Gower's tract. The irregular wedge-shape is retained throughout this region, the borders of the degenerated being sharply defined from the normal tissue.

In the uppermost region of the cervical cord, the sclerotic zone again moves slightly forward (ventrally) until it comes almost directly into the Gower's tract, then at the level of the lower portion of the pyramidal decussation it decreases perceptibly in size, and at length becomes reduced to a narrow band along the anterior border of the cord, completely within the Gower's bundle.

The sclerotic tract now rapidly decreases in size until it is finally lost at the level of the uppermost portion of the decussation, no degenerated fibres being found in the direct cerebellar tract or extending in the direction of the nucleus lateralis. The cells of this nucleus are numerous, not atrophied in the least, and do not differ in any way from those in the adjacent nuclei of origin of the nerve roots. Sections carried through the medulla and pons failed to show any further degenerated tracts. From the lowermost dorsal to the level of the lower cervical enlargement, the fibres contained in the posterior commissure were much less numerous than usual.

Except in the sclerotic fasciculi, an examination of the neuroglia cells failed to show any participation on their part in the morbid process. While in places about the root fibres of the nerves or origin, the pia was to some extent thickened, this alteration was never considerable, and what thickening there was of the membrane was dependent upon an hypertrophy of the fibre elements and not upon multiplication of round cells.

To recapitulate:—The fundamental pathological basis for the various nervous phenomena described in the clinical history of the case is as follows: (1) A hyaline-fibrous degeneration of the arterial system existed, which was not confined to the central nervous regions, but was equally evident in the roots of the spinal nerves and in the skin tissues. The degree of alteration varied from slight thickening of the muscular layer to complete closure of the lumen from hypertrophy of the middle coat of the vessel walls. The morbid change was

accordingly not uniform, but reached its maximum of intensity in the vessels of the lower dorsal cord, the meninges of the bulb and cord, and also in certain of the root bundles of the cerebro-spinal nerves. (2) As a consequence of the vascular lesions there were degenerations of an atrophic order in the nerve cells of the gray horns of the cord, more particularly in those of Clark's column, and in the medulla oblongata. To this alteration in the central nervous substance at least a portion of the various symptoms must be attributed.

Besides the principal lesions there were others of considerable, though minor importance.

The degeneration of scattered fibres in the bundles of the spinal and bulbar nerves played some part in the general symptomatology, being shown during life by the lowering of tone as regards the innervation of the muscles, as well as by disturbances of the functions of the nerves extending from the terminal apparatus.

The sclerosis of a portion of the outer zone of Burdach's column would signify that fibres ascending through the posterior root zones were degenerated, though the small area involved shows that their numbers were inconsiderable. The lesion of the tract itself has but little significance, the fibres involved belonging to short inter-connecting bands.

The lesion of the direct cerebellar tract is not only of more importance, but presents some rather peculiar features. The absence of the majority of the medullated fibres from the posterior commissure, over considerable regions of the medulla spinalis, favors the view that a portion of the cerebellar bundle is formed from the fibres of this commissure. The gradual change of position in the sclerotic area shows also that the fibres—at least in this instance—do not proceed directly upward in the column, but are gradually diverted as other fibres enter, and assume a more and more anterior position; and, furthermore, that a portion of the fibres are lost in the upper cervical and lower regions of the medulla and do not proceed to higher levels. This ending of the ascending fibres has been ascertained for a part of Gower's bundle but is not usual in the case of the component medullated fibres of the direct cerebellar tract. At its beginning, the degenerated area almost touched the left posterior root zone while in the upper cervical region it verged upon, if it did not enter, the area assigned to Gower's bundle. The total disappearance of the degenerated area at the lowermost level of the medulla may be considered to have sufficient anatomical value upon which to base the theory that in the so-called direct cerebellar tract other fibre bundles, which are at present unknown, enter into its formation, and that they correspond more closely, in their manner of termination, to the bundles of the Gower's system than to those of the cerebellar paths. The department of the sclerotic fasciculus may also give rise to the supposition that we have to do more here with an undescribed bundle, running from the dorsal to the uppermost cervical region.

As an explanation of the numerous symptoms of the case it would appear most reasonable to suppose the existence of a disease-process affecting simultaneously both the peripheral and central nervous systems. Assuming that the arterial lesions were of late specific origin—and of this there can

but little reasonable doubt—a chronic progressive involvement of the nutrient channels, here and there leading to marked narrowing or even to closure of isolated vessels, might certainly have produced just such a train of symptoms as was present. Of primary importance would be the involvement of the arteries of the anterior and posterior nerve roots of the bulbo-spinal system, though the direct lesions of the nutrient supply to the terminal nerve apparatus—which have to be inferred as they could not be definitely determined—would be of equal value. This inference of the implication of the end-apparatus is justifiable, since the arterial degeneration in the skin was quite extensive, and whenever there is starvation of a nerve tissue there result pathological reactions which may be manifest in a multitude of ways.

The slowly progressive character of the symptoms is also consistent with the theory of tissue-starvation. All the lesions of the nerve cells of the cord and bulb are of this type—atrophy and pigmentary degeneration from malnutrition. Whenever nutrition is at a low ebb, metaplastic granules accumulate in the protoplasm of the cell.

The condition of the optic tracts—in which the lesions are identical with those of other nerve roots except that they are more advanced—would argue that the thickening of the blood-vessels was of long standing, and that only when the process had advanced to an extreme degree did any definite symptoms show themselves. This is exemplified more particularly in the state of the cortex cerebri. Though in this

region vascular disease was manifest and diffuse, it had not advanced nearly to such an extent as in the gray matter of the dorsal cord or in the adjacent meninges. As a consequence, the functions of the cortex, while not as perfect as in youth, were not reduced to the same low level as those of the cord and bulb.

One pathological fact should be remembered in considering the clinical symptoms, namely, that it is not necessary for a vascular lesion to proceed to such a profound degree as to cause the entire shutting off of the nutrient supply before a nerve tissue will show signs of deviation from its normal functions. With a reduced supply of nutrient plasma, definite manifestations of nervous exhaustion are brought about, and these are not due to a degeneration of the component portions of the neurone which is visible in the tissue after death, by our present methods of preparation, in the form of morbid alterations of the cytoplasm, axone or myelin. Long before this stage is reached the entire neurone is incapable of performing its natural functions in an efficient manner, and as a consequence, anæsthesias, paræsthesias, diminution or exaltation of the reflexes, and dulling of the special senses can be noted. Almost precisely similar results are encountered in advanced stages of progressive paralysis, especially in the syphilitic cases in which, when vascular lesions of the arteries of the cerebrum and cord have advanced to a profound degree, there is a gradual but progressive dulling of cutaneous sensibilities and special sensations.

CONGENITAL MALFORMATIONS OF THE HEART AS ILLUSTRATED BY THE SPECIMENS IN THE PATHOLOGICAL MUSEUM OF THE JOHNS HOPKINS HOSPITAL.

BY W. G. MACCALLUM, M. D., *Assistant in Pathology.*

The literature on the congenital malformations of the heart is very extensive, but is well represented by the works of Rokitsky,* Peacock,† Rauchfuss‡ and Vierordt.§ That of Rokitsky, dealing with the defects of the septa, is, perhaps, the foundation of our accurate knowledge of these anomalies, while Rauchfuss, Peacock and others have added greatly to the observations of anomalies of the heart in general, and have done much to determine their relations to one another. Vierordt, writing in the light of the more recent embryological work of His and Born, presents the whole subject in the most concise and lucid way.

The following is intended to be a brief synopsis of the various malformations to serve as the legend to the photographic illustrations which are taken from the specimens in the pathological museum, and also in a way as a catalogue of those specimens:

* Rokitsky: *Die Defecte der Scheidewände des Herzens.* Wien, 1875.

† Peacock: *On malformations of the human heart, with original cases.* London, 1858.

‡ Rauchfuss: *Die angeborenen Entwicklungsfehler des Herzens.* Erhardt's Handb. d. Kinderkrankh. Tübingen, 1878. Bd. IV, 1 bth.

§ Vierordt: *Die Angeborenen Herzkrankheiten.* Wien, 1898.

A.—*Open foramen ovale.* This is perhaps to be considered a malformation only when the defect is large, as it is so extremely common to find a small interauricular opening well guarded by the valvula foraminis ovalis. Even when widely open in persons who have reached adult life, the symptoms it produces are indefinite or none. It may occur pure or in association with a variety of other defects. The symptoms are more definite when it is associated with mitral insufficiency, for there is then pulsation of the veins of the neck. The so-called paradoxical embolism is the result of the passage of the embolus through the open foramen into the systemic arteries, by which means the sifting-out action of the pulmonary circulation is avoided.

FIG. 1 shows a glass rod passed through the foramen ovale. The fossa ovalis in this case is deep and the valvula foraminis ovalis bulged into the left auricle. It was, however, able to completely close the opening.

B.—*Defects in the septum ventriculorum.* Rokitsky considered the pars membranacea as derived from the ventricular wall, while more recent writers trace its origin to the aortic septum; defects in the septum are most commonly in this small area, the "undefended space" of English writers. They may, however, be at other points in the septum, seldom near the apex. The defect seldom occurs pure, but is oftenest associated with narrowing of the pulmonary orifice. Cyanosis

appears when the pulmonary is narrowed (Roger's disease), and there is generally a single, loud, constant murmur in the upper median præcordial region, beginning in systole and covering both sounds. The absence of a murmur in diastole is explained by the covering of the defect by the tricuspid and mitral valves.

Aneurismal dilatation of the membranous portion of the septum may occur, the saccular projection appearing in the right ventricle underneath the tricuspid leaflet to which it is often attached. This sacculatation may be actually perforated, but neither of the two specimens in this collection shows this perforation.

The origin of this condition is variously explained as being due to arteriosclerosis, differences in intracardiac pressure, and traction by the adherent tricuspid leaflet.

FIG. 2. The pars membranacea septi is pierced by a round hole about 1 cm. in diameter. The pulmonary orifice in this case was narrowed by a thickening and contraction of the valves.

FIG. 3. The pars membranacea septi is in this case bulged into the right ventricle, forming a saccular projection beneath the tricuspid valve. The mouth of this sac is seen just below the aortic valves.

C.—*Stenosis of pulmonary.* This is the commonest of the malformations of the heart. It is explained as due either to abnormal division of the truncus arteriosus or to congenital inflammatory disease. The narrowing may occur in or above the valves, by the constriction of a fibrous ring in the artery or lastly by a constriction in the conus.

It is often associated with defects in the septa. The right ventricle is hypertrophied unless the pulmonary is completely atresic and the septum ventriculorum closed.

Clinically there is cyanosis with various sounds on auscultation, none of which are typical. Often there is a loud systolic murmur in the 2nd and 3rd left interspaces. The 2nd pulmonary sound may be weak, but is strong if the ductus arteriosus is widely open.

The so-called "Rechtslage" is a condition in which extreme narrowing of the pulmonary orifice is associated with a wide defect in the septum ventriculorum and a shifting of the aortic orifice so that it opens directly over the septum and thus communicates with both ventricles.

FIGS. 4 and 5. "Rechtslage." A, stenosed pulmonary orifice; B, aorta opening into each ventricle; C, mitral, and D, tricuspid orifice. In Fig. 5 a rod is passed through the left ventricle from its apex into the aortic orifice. The figure shows the aortic orifice as seen through the right ventricle.

As regards the general idea that tuberculosis of the lungs is especially frequent in cases of pulmonary stenosis, it is found by a consideration of the statistics that while tuberculosis is frequent in these cases it is not relatively more so than in the other conditions (of heart and general) that produce a predisposing depression of the nutrition of the pulmonary tissues.

D.—*Anomalies in the division of the truncus arteriosus.*

1. Persistence of truncus due to a failure of division.
2. Stenosis or atresia of the pulmonary from the defective course of the dividing septum.
3. Transposition of the arterial ostia.

Rokitansky's classical work on the transposition of the arterial trunks has lent a great theoretical interest to this group; but as the collection contains no representative, no illustration is given. With transposition of vessels we may have the vessels opening from their proper ventricles or from the opposite ventricles, this depending on the behavior of the septum membranaceum, which by a change in its relation may correct the anomaly. There is generally extreme cyanosis, but this may be prevented by a widening of the bronchial arteries.

E.—*Anomalies in the semilunar valves.* Anomalies in the semilunar valves occur more often at the pulmonary orifice than at the aortic. At either orifice there may be but two segments, or on the other hand there may be four or five. They have been explained as due to an excess of the endocardial cushions which go to form the valves.

F.—*Anomalies in the aorta.* The ductus arteriosus may persist as an open communication between the arterial trunk with hypertrophy of the heart. No cyanosis and sometimes systolic murmur in the 2nd left interspace.

Stenosis or obliteration of the aorta near the entrance of the ductus arteriosus is not uncommon. The stenosis assumes various forms and relations to the position of the ductus—the point of predilection is in the isthmus aortæ. The pulmonary is dilated and the arch of the aorta and the arteries springing from above the structure greatly widened. Collateral circulation to the lower portions of the body is effected by anastomoses between the internal mammaries and intercostals. The pathogenesis of the condition is rather obscure. The process is by some thought to be an extension of the obliterative changes going on in the ductus.

There is seldom cyanosis; sometimes œdema; the superficial arteries become tortuous and pulsate visibly, there is inequality in radial and femoral pulse and often a systolic murmur varying in its location.

FIG. 6. Stenosis of aorta (B) just below entrance of ductus arteriosus (C). A is placed upon the widened pulmonary artery. The specimen shows great dilatation of the arterial branches and arch of aorta above the stricture.

G.—*Anomalies in the auricular ventricular valves.* The remaining anomalies are chiefly those affecting the tricuspid and mitral valves, and these cases are so rare that it is difficult to make any general statements concerning them.

The representative of this group in the collection is so curious that it seems to deserve to be reported in some detail.

The case was that of an artist who had always been blue and who died at the age of 30 of pulmonary tuberculosis. At the autopsy there was found to be a chronic tuberculosis of the lungs, with chronic passive congestion of the viscera. The heart was enlarged, the enlargement being especially on the right side. The Eustachian valve is found to persist as a large apparently functional valve. The valvula foraminis ovalis also persists, but is not competent to close the foramen ovale, which is open to a width of about 1 cm. The very large appendix auriculæ opens by two mouths into the auricle, which is somewhat constricted near its middle by a muscular ring.

The tricuspid valves are ballooned out into the right ventricle and have apparently become closely grown together with the ventricular wall. Two of the segments are visible against the interventricular septum and toward the left—these are wrinkled and folded membranes, which are very soon fused with the ventricular wall and are apparently functionless. The remaining segment seems to furnish the whole membrane which lines the ventricular wall and septum; and below, roofing the trabeculæ, forms the floor of a sort of intervalvular chamber. This chamber opens into the ventricle through a round opening, situated toward the left, just below the conus arteriosus and guarded by a flap-like fold of the chamber wall. It further opens through several small openings, each guarded by tiny valves which are furnished with chordæ tendineæ and papillary muscles. The pulmonary artery is slightly narrowed, and the ductus arteriosus persists as a cord, but otherwise the heart is approximately normal.

Ebstein * has reported a case in which the malformation of the heart coincides in every detail with this one, and although no other such cases are reported the recurrence of the malformation in every detail suggests in a way that cannot be ignored the existence as a cause of a definite sequence of events. A possible explanation is as follows: The valves are, of course, formed on the medial side by a prolongation from the septum intermedium—on the lateral side by an involution of the wall of the auricular canal. If in an early stage these endothelial cushions reach a greater extent than normal, and retain their attachment to the muscular trabeculæ, they would in time become a membrane, supported by muscular trabeculæ. This might occur only on the lateral side, the

valves produced from the septum, developing in part normally. The free edge has possibly lost its muscular attachment as a result of the inefficiency of muscular action in the direction in which the blood stream affects it.

The association of pulmonary tuberculosis with this malformation (also observed in Ebstein's case) is interesting in connection with what was said above as to pulmonary stenosis. Naturally the effect of such an insufficiency of the tricuspid—for the mere presence of a large inner chamber, acted upon by the contraction of the ventricle, but not guarded from the auricle constitutes an insufficiency—is the same as that of the pulmonary stenosis in producing a poor nutrition of the lung tissue. The compensating persistence and development of the Eustachian valve is also to be noted.

FIGS. 7 and 8 illustrate this malformation. FIG. 7 shows the right auricle and ventricular portion of the heart laid open. The open foramen ovale (A), and the two mouths of the auricular appendix are readily seen; B points to the large round opening into the ventricle; C, the apical portion of the functional ventricle; D, the medial leaflets of the tricuspid valve.

In FIG. 8, the conus arteriosus pulmonalis is laid open, showing the larger portion of the functional right ventricular cavity with the opening B just below the pulmonary orifice and guarded by the flap-like valve.

In connection with several malformations, it may be stated that the theories as to their origin, ascribed them formerly either to a true congenital malformation, or to a foetal endocarditis. The majority of authors, however, now lean to the view that the rôle of foetal endocarditis is relatively unimportant, and that the vegetations so often seen on malformed valves, on the edges of septal defects, etc., are to be explained as the result of the predisposition of such malformed parts to inflammatory processes.

* Ebstein. Arch. f. Anat. and Phys., 1866, S. 238.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

THOMAS R. BROWN, M. D. Internal Medicine.—*Maryland Medical Journal*, February, 1900.

ROBERT REULING, M. D. Pathology.—*Maryland Medical Journal*, February, 1900.

HUGH H. YOUNG, M. D. Surgery.—*Maryland Medical Journal*, February, 1900.

WILLIAM OSLER, M. D., and THOMAS McCRAE, M. D. Latent Cancer of the Stomach.—*Philadelphia Medical Journal*, February, 1900.

HENRY J. BERKLEY, M. D. General Pathology of Mental Diseases.—*American Journal of Insanity*, January, 1900.

HENRY J. BERKLEY, M. D. Transitory Alienation Following Distressing Pain.—*American Journal of Insanity*, January, 1900.

WILLIAM OSLER, M. D. After Twenty-Five Years.—*Montreal Medical Journal*, November, 1899.

PATRICK CASSIDY, M. D. Report of a Severe X-Ray Injury.—*Medical Record*, February 3, 1900.

IRVING PHILLIPS LYON, M. D. The Inoculation of Malaria by the Mosquito.—*Medical Record*, February 17, 1900.

LEWELLYS F. BARKER, M. D., and JOSEPH MARSHALL FLINT. A Visit to the Plague District in India.—*The New York Medical Journal*, February 3, 1900.

THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital reports of lectures, and other matters of general interest in connection with the work of the Hospital is issued monthly.

Volume XI is now in progress. The subscription price is \$1.00 per year. The set of ten volumes will be sold for \$20.00.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, February 5, 1900.

The meeting was called to order by the President, Dr. H. M. Thomas.

Exhibition of Patients.—DR. W. B. PLATT.

CASE 1.—Infant, seven months old, came to the Garrett Hospital when five months of age with a sinus just below the right eye and a history that pus occasionally escaped from the right nostril. An examination showed an empyema in the right antrum with necrosis of the bony wall in at least two places. The sinus above had caused contraction of the lower eyelid. There is also an opening into the nose apparently one-eighth inch in diameter. I removed a molar tooth as the best way of getting a free opening into the antrum to clean it out. The child improved immediately, the sinus above healed up, and the discharge was not more than a drop a day, and the child was sent home. A small piece of necrosed bone was also removed from the alveolus.

The child returned in seven weeks with the history of a recurrence. Pus now escapes through the right nostril and from the sinus below the right eye. I do not find any record of cases similar to this in infants, and the exact cause is not clear. It may be an osteomyelitis. The probability is that there was an abnormally large opening from the antrum into the nose which became infected during child-birth, with subsequent involvement of the delicate bone wall.

CASE 2.—This boy, seven years old, has a curious defect, a hole $\frac{1}{4}$ inch in diameter in the palatoglossus muscle of the left side. There is every reason to believe that it is a congenital defect. Of course, one may suppose it a case of congenital or inherited syphilis, but in view of the frequent defects in the development of the soft palate, it is probably one of this kind.

CASE 3.—This is a case of congenital hip-joint dislocation. The girl, six years old, was sent to the Garrett Hospital from Virginia, with the history that she had always limped, and became fatigued on prolonged exertion. An examination of the right limb will show you that it is not hip-joint disease. She has perfect mobility, not the slightest hampering of the movements of the limb and no bowing up of the lumbar region on flexion of the thigh on the pelvis. On first looking at it I thought of infantile paralysis, because the whole limb is somewhat atrophied in appearance as compared with the other. The distance from the right anterior superior spine to a horizontal line drawn through the right trochanter is three-quarters of an inch less than corresponding measurements on the left side. On drawing down the right thigh limb and letting it go we get a distinct, though slight, telescoping.

What is to be done with children of this sort? If the telescoping amounts to three or four inches, if the gait is very bad, or fatigue or pain follows moderate exertion, an operation must be done. Statistics show that after two or three years the hip in many cases again telescopes. A man of large experience has said that fifty per cent. of the operated cases relapse. This little girl walks and runs so well that we

have tried only massage to increase the strength of the gluteal muscles. Some cases have done well by use of the ordinary hip-joint apparatus to keep the hip extended and pressed into the socket for some months. A certain number of these cases never have anything more than a slight limp.

Changes in the Cells of the Nucleus Dorsalis resulting from Pressure upon the Upper Portion of the Spinal Cord.—DR. BARKER.

The specimen is from a case of compression of the upper part of the thoracic cord, the section being taken from the lower part of the thoracic portion. It will be recalled that the thoracic portion of the cord is characterized by the presence of a column, or nucleus, of gray matter on each side called Clarke's nucleus, or the nucleus dorsalis. The cells in this nucleus, give off axis-cylinder processes which run out into the dorsolateral region of the cord and then turn upward, ascending through the cord to the cerebellum, the whole bundle being known as the fasciculus spinocerebellaris dorsolateralis, or direct cerebellar tract. If one cuts through a medullated axone, there result changes in the whole neurone. If the axone of a neurone be cut anywhere between its cell-body of origin and the end of its axis-cylinder process, the nucleus becomes displaced in the cell-body, assuming an eccentric position, usually very close to the axone hillock; in addition to this change the tigroid masses, or Nissl bodies, break down into very minute granules, like fine dust, which become diffused through the cell. If the ulnar nerve, for example, be cut, one finds in the spinal cord that all the cells which give origin to the fibers of the ulnar nerve show this peculiar form of degeneration—so-called "reaction at a distance." If then the cells of Clarke's nucleus send their axones to the cerebellum, we should expect, in compression of the upper thoracic cord, to find this change below the lesion in all the cell-bodies which send their axis-cylinder processes to a part of the cord above the lesion. Accordingly sections from this cord below the lesion ought to show degeneration of the cells of Clarke's nucleus. The specimen under the microscope illustrates the alterations well. The cells show the change described in varying degrees of intensity. I have before pointed out the occurrence of similar changes in the nucleus dorsalis in inflammations of the soft meninges (*Brit. M. J.*, Lond., 1897, ii, pp. 1839-1841). The superficial position of the fibers of the direct cerebellar tract makes it especially liable to injury.

Area of Necrosis in Internal Capsule in Typhoid Fever.—DR. BARKER.

It was not easy to make out the lesion when the brain was first cut up. The brain was put into formaline immediately after its removal and was divided by the method of Petri some days later. On cutting through the brain it was found that the formaline had not penetrated the whole substance of each hemisphere, there being a large area that was soft. No definite area of necrosis was made out. In view of the marked clinical symptoms it seemed necessary to keep the tissue o

the right side for microscopic examination. These pieces were put back into the formaline in order to complete the hardening.

The hardening has now become complete and the lesion is perfectly well-defined and easily visible. It is an area of softening in the upper part of the right internal capsule, about the size of a small hickory nut, situated just lateral from the caudate nucleus a little medial and slightly dorsal from the upper border of the cortex of the island of Reil.

The necrosis must have involved practically all of the fibers of the pyramidal tract on the right side, and is undoubtedly due to a plugging of a branch of the artery supplying the area. The tissue is to be thoroughly worked up microscopically, but it seemed to be worth while before cutting the pieces into sections that the gross lesion should be presented to the Society.

Poisonous Snakes.—DR. KELLY.

Dr. Kelly concluded his demonstration of the poisonous snakes of North America by exhibiting: 2 specimens of *Elaps fulvius*, one of which had caused the death of a man by biting him in the hand; 1 boa constrictor (young) showing remarkable difference from native snakes in the fine bead-like appearance of the body due to the scales in 83 rows, and the peculiar pear-shaped head also covered with minute scales; *Sistrurus miliarius*, or ground rattlesnake; 2 large diamond-back rattlesnakes; 1 living moccasin, *Trigonocephalus discivorus*; 1 mountain blacksnake, *Bascanium constrictor*; and casts of snakes made by Mr. John W. Thompson, of the Philadelphia Zoological Gardens, one finely colored Texas copperhead, one very large diamond-back rattlesnake, and one very large moccasin.

NOTES ON NEW BOOKS.

An Experimental Research into Surgical Shock. By GEORGE W. CRILE, A. M., M. D., Ph. D. Svo. pp. 160. (Philadelphia: J. B. Lippincott Company, 1898.)

Due mainly to the leadership of the German and French schools of pathology, the research work of most surgical laboratories in this country to-day is devoted largely to the investigation of problems which the comparatively modern subjects of pathological histology and bacteriology have offered for solution. In consequence it has gradually come about that the methods of investigation best known to the physiologist have fallen into abeyance in spite of the valuable data relative to surgical principles which may be obtained by their employment. Prompted by some preliminary research conducted in the laboratory of his quondam preceptor, Dr. Victor Horsley, Dr. Crile, making use of physiological methods of experimentation, has undertaken an investigation concerning the nature of surgical shock; a subject which has always been somewhat nebular in its indefiniteness and offering problems the solution of which can only be approached by employing these methods.

The results of this excellent piece of work are comprised in a small volume of 160 pages which received the Cartwright Prize in 1897.

The essay represents the results of entirely personal observations, and in this lies, perhaps, the chief occasion for congratulation; and yet, on the other hand, for criticism of the author's published work, the value of which, considerable as it now stands, would have been

greatly enhanced as a book of reference had the bibliography of the subject been given, and the comparative results of other investigators in the same direction been cited. A cursory review of the theories of shock advanced by various writers is contained on the introductory four or five pages of the volume without references to the articles which have evidently been consulted.

After a brief description of the "Modes of investigation and annotation" which, though original with the author, are those commonly employed in the physiological laboratory, the chief part of the essay (100 pages) is given up to the detail of the individual protocols of the 148 experiments upon anesthetized dogs.

In these experiments, observations were made of the effects upon the respiratory, cardiac and vascular mechanism of all conceivable forms of traumatism upon the individual tissues and organs of the body, somatic, splanchnic and neural. These experiments evidence the author's thoroughness and ingenuity, and though their record, from necessary repetition, makes the protocols uninteresting reading, an excellent index renders it possible to abstract data from them, otherwise buried in the mass of material, which will be of value to those pursuing similar lines of investigation.

The author has given an interesting summary of his experimental findings in the latter part of the volume, with 35 composite charts of manometric readings, illustrating the effects produced upon the blood pressure by the various experiments. These included procedures showing the rise in blood pressure consequent upon burning the skin, injuries of the periosteum, dilatation of the sphincter ani, etc.; procedures showing the negative effect of certain manipulations, as upon the joints: procedures showing the great "depressor" effect of cutting away the cerebral hemispheres, of manipulation of the larynx, the testicle, the parietal peritoneum, the intestines, etc. It was furthermore demonstrated that when an animal was exhausted, as late in an experiment, and with shock present or pending, the application of stimuli, ordinarily producing a temporary rise in blood pressure, under these circumstances would be followed by a fall.

Possibly, from a practical standpoint, the most valuable suggestions from Dr. Crile's work originate in the results of his observations upon the "blocking" effect of the preliminary local administration of cocaine as a preventive measure toward shock in anticipation of those peripheral manipulations which ordinarily have a marked depressor effect. This is most strikingly shown in one of the composite charts (near page 127. These charts unfortunately are not numbered) which illustrates the great fall in blood pressure which ordinarily follows upon manipulations of the larynx, and the inhibitory effect of preliminary cocaineization of the mucosa upon this fall.

As prophylactic measures toward shock the author emphasizes the necessity of careful hæmostasis under all circumstances; of atropine in operations on the larynx or in procedures which might cause mechanical stimulation of the vagi; of a proper respect for tissues and the avoidance of tearing or finger dissections unfortunately used by many operators. Precautions toward over-anæsthetization, especially with chloroform, are dwelt upon as most likely to occur in those operative procedures which are associated with an acceleration of the respiratory rate, and in abdominal, anal and other operations. Emphasis is also laid upon the likelihood of shock, in consequence of operations in the gall-bladder or pyloric region, due to pressure on the venous trunks, diaphragm and splanchnic nerves. He truly says, "The severity of shock produced in abdominal operations is in direct ratio to the distance from the pelvis."

Dr. Crile offers nothing new in the matter of treatment, believing that small and frequently repeated hypodermic injections of strychnia and intravenous saline infusions to be the most efficacious measures, with elevation of the lower extremities, application of heat, etc. Emphasis is rightly given to the fact that intelligent prevention is more valuable than treatment.

In the etiological factors producing shock the author does not seem in his views to differ widely from the theories proposed by Fischer, Goltz and Seabrook. An attempt is made to differentiate *collapse* and *shock*, the latter being regarded as especially dependent upon "vasomotor impairment or break down," the degree of shock being proportionate to the failure of the pressor action. Factors, cardiac, respiratory and hemorrhagic, may add to shock, or, if their effects are severe and immediate, may produce collapse. Certain widespread vasomotor action, as that following section of the splanchnic nerves, may, however, produce the same condition.

Dr. Crile's work is important in the effect it will have in stimulating investigation of surgical problems on physiological lines. It is to be hoped that observations by the methods of Nissl will be made upon the histological changes in the medullary nerve centers and ganglia responsible for these vasomotor disturbances, and also that mercurial manometers, constructed so as to be applied to the extremities, may be employed in surgical operating-rooms for the purpose of recording vasomotor effects and changes in blood pressure, and to indicate impending shock more definitely than at present is possible through the medium of the anæsthetizer's finger on a peripheral artery.

CUSHING.

Essentials of Diseases of the Skin, including the Syphilodermata, arranged in the form of Questions and Answers prepared especially for Students of Medicine. By HENRY W. STELWAGON, M. D., Ph. D., Clinical Professor of Dermatology in the Jefferson Medical College, etc. Fourth Edition, thoroughly revised. Illustrated. (Philadelphia: W. B. Saunders, 1899.)

In the present edition, the whole book has been subjected to careful scrutiny and revision, and the text has undergone numerous small but important changes in order that it may reflect the present state of knowledge of cutaneous diseases. The rarer affections like hydroa vacciniforme, blastomycetic dermatitis, and erythema induratum are briefly but adequately described. The book is extremely useful to students of medicine who wish to review the subject.

A Text-Book of Embryology for Students of Medicine. By J. C. HEISLER, M. D. (Philadelphia: W. B. Saunders, 1899.)

The work thus presented to us is an attempt to supply the real need of a concise text-book of embryology, written in the English language, and planned especially for the average medical student who is learning anatomy.

A few words will characterize the book. It is not a new account, but a condensed familiar one. It is a fairly straightforward statement of human development, such as one might write who was acquainted with anatomy, and who wrote the embryological story from a reliable knowledge of four or five well-known text-books; as, for instance, Mark's translation of Hertwig's work (the influence of which is very strongly manifest); the American text-book of obstetrics; Minot's embryology; Piersol's histology, etc.

The press-work is good, and large-type headings are convenient for reference. Comparative references and discussions are eliminated wherever possible; making it easy to quickly find the main facts of development as here given for any special structure.

The weakest portion of the book is that devoted to the earlier phenomena: fertilization, the ovum, maturation, the sperm, cleavage, germ-layers, foetal appendages, etc.

On reading these pages (and the same is true of other sections), we wonder how the writer of a text-book to-day can be satisfied with such an antiquated and incomplete résumé. Certainly, there has been no lack of remarkable discoveries and well-founded generalizations by the embryologists and cytologists of the last ten years, from which to formulate a modern and comprehensive statement, however brief.

In all fairness to the science it attempts to treat, a good text-book

should be at least up to date, representing the most recent advances in all lines of investigation. The book before us would be greatly improved by the incorporation of what is found to be valuable after a judicial sifting of the original contributions of recent embryological research.

We must not, however, be too severe on those who seek to adapt the good work of others to a special need—a difficult task. Even if the result be little more than a fairly clear restatement of the conceptions of two or three master minds, who have already brought together the main threads of research, those who may be introduced to the subject in this indirect manner, will, at any rate, receive many valuable and reliable facts.

H. MC. E. K.

Essentials of Anatomy, including the Anatomy of the Viscera arranged in the form of Questions and Answers prepared especially for Students of Medicine. By CHARLES B. NANCREDÉ, M. D., Professor of Surgery, etc., in the University of Michigan. Sixth Edition, thoroughly revised by FRED. J. BROCKWAY, M. D., Asst. Demonstrator of Anatomy, Columbia University, New York. (Philadelphia: W. B. Saunders, 1899.)

This is a thoroughly revised sixth edition of a useful little book which has been approved by long service in medical schools and training schools for nurses. It is concise without the sacrifice of clearness, and the excellent illustrations assist the text.

The Hygiene of Transmissible Diseases; their Causation, modes of Dissemination and methods of Prevention. By A. C. ABBOTT, M. D., Professor of Hygiene and Bacteriology, and Director of the Laboratory of Hygiene, University of Pennsylvania. Illustrated. (Philadelphia: W. B. Saunders, 1899.)

As the title indicates, this volume of 300 pages gives an account of transmissible diseases with details, more or less complete, as to their proper and successful management. The section on the causation of disease is probably the most satisfactory and philosophical of the whole book. It treats of the influence of age, sex, race, occupation, density of population, heredity and season, upon diseases in general; and also of chemical, physical, mechanical, parasitic and bacterial agencies as exciting causes of the actual development of diseases. This section is well illustrated by tables, charts and diagrams. The following section, on the causation, modes of dissemination and prevention of special diseases, contains much information as to diseases which are transmitted from one person to another. The account which is here given of the bacteriology of transmissible diseases is full and extremely satisfactory, as would naturally be expected from so accomplished and skillful an observer. The sections on prophylaxis and disinfection are also valuable, and the directions which they contain are sensible and practical. The book is well calculated to meet a want which has long been felt by physicians and nurses.

The Bulletin of the Ohio Hospital for Epileptics, Vol. I, Nos. 1 and 3. Gallipolis, O. The Hospital, 1898.

The volume consists of a number of papers by Dr. A. P. Ohlmacher with an introductory statistical report by H. C. Rutter, manager of the hospital. The first two of Dr. Ohlmacher's papers form an account of the autopsies in cases of epilepsy performed during his service, which he prefaces with a somewhat detailed description of rather ordinary autopsy technique. In these cases, special attention has been directed to the association of the lymphatic constitution with epilepsy, and throughout the report the effort is made to show that "idiopathic" epilepsy may perhaps be the direct result of the presence of the "constitutia lymphatica." It is sometimes difficult to follow the chain of arguments which connects the lymphatic constitution with epilepsy, rhachitis, tetany and exophthalmic goitre on the one hand and with the causation of gliomata on the other.

Two other papers are concerned with the description of various tumors of the central nervous system, with secondary epileptic symptoms. It is to be regretted that amid the profusion of illustrations there are no drawings of the microscopical appearances of the tumors to supplement the descriptions. In the fifth paper, there is described the case of an idiot child with immense thickening of the skin and subcutaneous tissues in association with atrophy of the thyroid, and another case in which there was a localized area of thickening of the skin without thyroid atrophy. Finally, the last paper is devoted to the description of tumors occurring in various animals.

The report is marked by a diffuseness which seems unfortunately common in neurological literature, but the suggestions contained are very worthy of confirmatory work. It seems especially desirable, too, that such work on comparative pathology as is embodied in the last paper should be more extensively carried out.

Manual of the Practice of Medicine. By A. A. STEVENS, M. D., of Philadelphia. (Philadelphia: W. B. Saunders, 1900.)

This is the fifth edition of this work, which shows its popularity. Any extended notice regarding the book is unnecessary. Dr. Stevens has succeeded in condensing much into 500 small pages. The material chosen, and the method of its arrangement, make it one of the best books of its kind.

The American Year-Book of Medicine and Surgery, edited by GEORGE M. GOULD, M. D. Medicine. (Philadelphia: W. B. Saunders, 1900.)

The current volume of the Year-Book is a welcome addition to the library shelves. In these days, unaided by the *Index Medicus*, the gleanings of the fields of literature has become a heavy and often well-nigh impossible task. In this the series of volumes of the Year-Book is of valuable help. The work is too well-known to require any description of its characteristics. This year sees a new departure in the division of the work into two volumes, which will be found most convenient. In one volume it was growing beyond the bounds of easy handling. Dr. Gould, in the preface to the volume on Medicine, notes some changes in the editorial staff. Dr. Riesman takes charge of the section on Pathology in place of Dr. Guit  ras. Drs. Wilcox and Stevens edit the department of Materia Medica and Therapeutics, while Dr. Abel is succeeded in Physiologic Chemistry by Drs. Hunt and Jones of Baltimore. The present volume sustains the previous high character of the work. Not the least useful feature is the complete index. We hope the work is having the pecuniary recognition that it deserves.

Deafness, Word and Mind-Blindness. By JAMES HINSHELWOOD, M. D., of Glasgow. (London: H. K. Lewis, 1900.)

These are lectures delivered before the Glasgow Medico-Chirurgical Society which appeared in the *Lancet* and are now published as a book of 85 pages. The writer takes up the general subject of usual memory and then discusses the various groups of cases designated in the title. He is able to report several cases of his own, which were unaccompanied by derangements of the auditory and speech-motor centers. From the study of his cases and those in the literature, the writer considers that there are separate cerebral areas for the usual memory of numbers, letters and words. The lectures are well and clearly written, and the study of the cases given throws light on an exceedingly interesting subject. Dr. Hinshelwood shows how much may be made out of a few cases by thorough analysis.

BOOKS RECEIVED.

Archives of Neurology and Psychopathology. Vol. II. Nos. 1-2. 1899. 8vo. 319 pages. State-Hospitals Press, Utica, N. Y.

Transactions of the Clinical Society of London. Volume the thirty-second. 1899. 8vo. LVII + 296 pages. Longmans, Green & Co., London.

Transactions of the Texas State Medical Association. Thirty-first annual session held at San Antonio, Texas, April 25-28, 1899. 8vo. 347 pages. Von Boeckman, Schutze & Company, Printers, Austin, Texas.

A Manual of Modern Surgery, General and Operative. By John Chalmers Da Costa, M. D. Second edition. With 386 illustrations. 1898. 8vo. 911 pages. W. B. Saunders, Philadelphia.

A Text-Book of Materia Medica, Therapeutics and Pharmacology. By George Frank Butler, Ph. G., M. D. Third edition, thoroughly revised. 1899. 8vo. 874 pages. W. B. Saunders, Philadelphia.

A Text-Book of the Practice of Medicine. By James M. Anders, M. D., Ph. D., LL. D. Third edition, revised. Illustrated. 1899. 8vo. 1292 pages. W. B. Saunders, Philadelphia.

A Manual of the Diagnosis and Treatment of the Diseases of the Eye. By Edward Jackson, A. M., M. D. With 178 illustrations and 2 colored plates. 1900. 12mo. 604 pages. W. B. Saunders, Philadelphia.

A Manual of the Practice of Medicine. Prepared especially for students. By A. A. Stevens, A. M., M. D. Fifth edition, revised and enlarged. Illustrated. 1898. 12mo. XV + 519 pages. W. B. Saunders, Philadelphia.

A Text-Book of Diseases of Women. By Charles B. Penrose, M. D., Ph. D. Third edition, revised. Illustrated. 1900. 8vo. 531 pages. W. B. Saunders, Philadelphia.

Hints on Elementary Physiology. By Florence A. Haig-Brown. With twenty-one illustrations. 16mo. 1897. XII + 121 pages. P. Blakiston, Son & Co., Philadelphia.

The Medical Annual Synoptical Index to Remedies and Diseases. For the twelve years, 1887 to 1898. 12mo. 411 pages. [1899.] John Wright & Co., Bristol. Simpkin, Marshall, Hamilton, Kent & Co., Ltd., London.

Progressive Medicine. A Quarterly Digest of Advances, Discoveries and Improvements in the Medical and Surgical Sciences. Edited by Hobart Amory Hare, M. D. Volumes I, II, III, IV. March, June, September, December, 1899. 8vo. Lea Brothers & Co. Philadelphia and New York.

A System of Medicine. By Many Writers. Edited by Thomas Clifford Allbutt, M. A., M. D., LL. D., F. R. C. P., F. R. S., F. L. S., F. S. A. Volumes VI, VII, VIII. 1899. 8vo. The MacMillan Company, New York.

Transactions of the American Ophthalmological Society. Thirty-fifth annual meeting, New London, Conn. 1899. 8vo. 469-592 pages. Published by the Society, Hartford.

Saint Bartholomew's Hospital Reports. Edited by Norman Moore, M. D., and D'Arcy Power, F. R. C. S. Vol. 35. 1900. 8vo. 356 and 246 pages. Smith, Elder & Co., London.

Transactions of the Louisiana State Medical Society. Twentieth annual session held at New Orleans, La., May 16, 17, 18, 1899. 8vo. 173 pages. New Orleans.

Practice of Medicine. A manual for students and practitioners. (Lea's Series of Pocket Text-Books) by George E. Malsbary, M. D. Series edited by Bern B. Gallaudet, M. D. Illustrated with forty-five engravings. 1899. 12mo. 404 pages. Lea Brothers & Co., Philadelphia and New York.

The American Year-book of Medicine and Surgery. Collected and arranged with critical editorial comments by S. W. Abbott, M. D., Archibald Church, M. D., et al. Under the general editorial charge of George M. Gould, M. D. Two Vols. 1900. 8vo. W. B. Saunders, Philadelphia.

Annual and Analytical Cyclopædia of Practical Medicine. By Charles E. de M. Sajous, M. D., and one hundred associate editors, assisted by corresponding editors, collaborators and correspondents. Volume IV. 1899. 4to. 622 pages. The F. A. Davis Co., Philadelphia, New York, Chicago.

Proceedings of the New York Pathological Society. For the years 1897 and 1898. 8vo. XVIII + 289 pages. 1899. Printed for the Society.

Seventh Report of the State Veterinarian of Maryland. December 1, 1899. 8vo. 249 pages. Baltimore.

Essentials of Anatomy, including Anatomy of the Viscera. Arranged in the form of questions and answers. Prepared especially for students of medicine. (Saunders' Question-Compend, No. 3.) By Charles B. Nancrede, M. D. Sixth edition, thoroughly revised by Fred. J. Brockway, M. D. 1899. 12mo. 419 pages. W. B. Saunders, Philadelphia.

Essentials of Medical Chemistry, Organic and Inorganic. Containing also questions of medical physics, chemical philosophy, analytical processes, toxicology, etc. Prepared especially for students of medicine. (Saunders' Question-Compend, No. 4.) By Lawrence Wolff, M. D. Fifth edition, thoroughly revised by Smith Ely Jelliffe, M. D., Ph. D. 1899. 12mo. 222 pages. W. B. Saunders, Philadelphia.

Essentials of Diseases of the Skin, including the Syphilodermata. Arranged in the form of questions and answers. Prepared especially for students of medicine. (Saunders' Question-Compend, No. 11.) By Henry W. Stelwagon, M. D., Ph. D. Fourth edition, thoroughly revised. Illustrated. 1896. 12mo. 276 pages. W. B. Saunders, Philadelphia.

MONOGRAPHS.

The following papers are reprinted from Vols. I, IV, V, VI and VIII of the Reports, for those who desire to purchase in this form:

STUDIES IN DERMATOLOGY. By T. C. GILCHRIST, M. D., and EMMET RIXFORD, M. D. 1 volume of 164 pages and 41 full-page plates. Price, bound in paper, \$3.00.

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It is customary in Germany for the pupils of a great teacher to express their appreciation and gratitude by dedicating to him a volume of their contributions to learning. The pupils of Dr. Wm. H. Welch, of Baltimore, have decided to give expression to their regard for him in a similar way and the publication of a volume to mark his twenty-fifth year as a teacher and investigator is now in progress.

During the past twenty-five years some seventy-five persons have undertaken investigation under Dr. Welch's leadership, and nearly half of these will contribute to the volume mentioned. The edition will necessarily be limited by the number of subscribers. An early announcement of the publication is made to give opportunity for subscription so that the committee can decide upon the number of copies to be printed.

The volume will be royal octavo in size and will contain at least five hundred pages of printed matter. It will, in addition, be illustrated with many lithographic plates and text figures. The price has been fixed at five dollars. The book will contain contributions to pathology and to correlated sciences agreeing in scope with that of the leading scientific medical journals.

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All communications and subscriptions should be addressed to Dr. F. P. Mall (Secretary), Johns Hopkins University, Baltimore, Md.

Baltimore, November 11, 1899.

HOSPITAL PLANS.

Five essays relating to the construction, organization and management of Hospitals, contributed by their authors for the use of The Johns Hopkins Hospital.

These essays were written by Drs. JOHN S. BILLINGS, of the U. S. Army, NORTON FOLSOM, of Boston, JOSEPH JONES of New Orleans, CASPAR MORRIS, of Philadelphia, and STEPHEN SMITH, of New York. They were originally published in 1875. One volume bound in cloth, price \$5.00.

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Volume XI is now in progress.

The subscription price is \$1.00 per year.

The set of ten volumes will be sold for \$20.00.

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OF

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AN UNUSUAL METHOD OF PERFORMING HYSTEROMYOMECTOMY.

BY OTTO G. RAMSAY, M. D., *Instructor in Gynecology, Johns Hopkins University, Baltimore, Md.*

An article in the Johns Hopkins Hospital BULLETIN of March, 1900, by Dr. Kelly, entitled "A Preliminary Report on the Surgical Treatment of Complicated Fibroid Tumors of the Womb, with a Description of Two New Methods," describes two unusual methods of performing hysteromyoectomy in difficult cases, which reminds me of a somewhat similar operation I performed for the removal of a myomatous uterus on September 23rd, 1898.

The patient, admitted to The Johns Hopkins Hospital complaining of "tumors of the womb," was 29 years of age, and had been sick for about seven years, beginning at that time to complain of abdominal pains. The abdominal tumor was first noticed by her six years ago, and it had increased in size considerably since then.

On examination, the abdomen was found distended, especially in its lower portion, by a symmetrical tumor, which, on palpation, was found to be composed of several nodules, the largest measuring about 15 by 15 cm.

By vaginal examination, a rounded tumor was felt lying in the cul-de-sac behind the cervix and extending downward between the rectum and the vagina nearly to the vaginal outlet. The cervix could not be found by the vagina, even under ether, being displaced above the symphysis, and the tumor itself was lying quite firmly pressed against the symphysis, giving the impression that the tumor was adherent in the

cul-de-sac. This rounded tumor was connected directly with the masses felt through the abdominal wall, and on pressure through the vagina the abdominal mass could be moved slightly. It was, however, impossible to move the growth much by making pressure either through the vagina or through the rectum. (See Fig. 1.)

Operation.—The usual median incision was made, taking the precaution to enter the peritoneal cavity high up rather than in the usual position, so as to avoid an elevated bladder. (Kelly.) On entering the peritoneal cavity, the bladder was found displaced upward, and when the incision was lengthened, it was seen bulging out above the symphysis pubis. On examining the relations of the tumor-mass and the surrounding structures to decide in what manner it might be best attacked, it was found that it could not be delivered through the incision usually made in a hysteromyomectomy, and, on further examination, the reason for this was discovered to be the extension of the growth into the cul-de-sac.

As the usual transverse operation could not be made, the next question was, by what new plan the growth might be removed. The tubes, with the broad ligaments and ovaries, were found raised up but lying somewhat anterior to the main mass of tumor, and on tracing them to their origin, the tumor was found to have arisen entirely from the fundus and posterior surface of the uterus, and the cervix and lower por-

tion of the body of the uterus could be recognized lying covered by the bladder on the anterior surface of the tumor proper. (See Fig. 2.)

In the first place, the vesical peritoneal reflection onto the uterus, which was much higher than usual, was definitely recognized and the peritoneum at this point incised, the bladder was then pushed down for a distance of 5 or 6 cm., exposing the lower portion of the body of the uterus and the cervix. When this had been accomplished, the uterine vessels on each side could be felt pulsating distinctly where they passed to the cervix. The plan of the operation which I then determined to follow was to tie the uterine vessels on both sides, then to cut across the cervix, and after that, to deliver the tumor from the cul-de-sac, thus reversing the usual steps in the operation. I first freed the ovaries from the tumor by a series of ligatures near the uterine cornu, as it was my intention not to remove them; this was easily accomplished, as their relations were not much distorted from the normal. The uterine arteries were tied just at the point where they curve up to reach the cervix. Then, as previously determined, the uterus was cut across from side to side, thus loosening the tumor entirely from its cervical and broad ligament attachments. The tumor was then fixed in the abdominal cavity only by its extension into the cul-de-sac; on attempting to raise it from this position, it was found densely adherent to the whole cul-de-sac and to the rectum posteriorly. These adhesions were carefully separated by raising the tumor slowly and dividing them with the finger as they came into view. The densest adhesions were found between the rectum and the tumor, and here some difficulty was experienced in the detachment, though a slow removal prevented any injury to the rectal coats. After removal of the tumor the remainder of the operation was carried out in the usual manner, the amputated cervix was closed in with catgut sutures, and the bare area on the floor of the pelvis cov-

ered by drawing the anterior and the posterior layers of the peritoneum together with catgut sutures. The large over-distended bladder was left puckered over the cervix, and the wound appeared as usual after a normal hysteromyomectomy. Several oozing points on the rectum were checked by fine catgut sutures, the peritoneal cavity was cleansed and the abdominal incision closed in the usual manner.

The convalescence was normal, save for a slight collection of blood above the stump of the cervix between it and the bladder, which was easily evacuated by dilating the cervical canal, otherwise the patient recovered in a perfectly satisfactory manner.

REMARKS.

The chief points of interest in this case are the peculiar developments of the myomatous tumor from the posterior surface of the uterus and its extension into the cul-de-sac, the upward displacement of the bladder covering the whole anterior surface of the uterus, and the method of attacking such a tumor.

Such a growth is rarely seen, and, therefore, this method of operation will only be useful in a certain number of abnormal cases. The principle, however, would seem to me to be a good one, and it might also be applicable in other conditions besides cases of posterior myomatous development. Thus for instance, in densely adherent pelvic structures, or in cases with large pelvic abscesses, it would be easier to separate the bladder from the uterus anteriorly where there are usually but few adhesions, and to tie the uterine arteries on each side before any attempt is made to remove the adherent masses thus obviating one of the chief difficulties in such an operation, namely, hæmorrhage from the misplaced or with difficulty accessible uterine artery.

The cervix, in these cases, could be cut across after tying the vessels, and a point of leverage obtained to remove more easily the adherent structures.

A SQUAMOUS-CELLED CARCINOMATOUS DEGENERATION OF AN OVARIAN DERMOID CYST ALSO AN ADENOCARCINOMA OF THE OVARY, ASSOCIATED WITH AN OVARIAN DERMOID CYST.

BY LINDSAY PETERS, M. D.

(From the Gynecological Department of The Johns Hopkins Hospital.)

Out of 7,600 patients admitted to the wards of the Gynecological Department of the Johns Hopkins Hospital since September, 1889, (there being 42 cases of dermoid cysts among that number), only two cases of carcinoma associated with a dermoid cyst have been observed. There was one case of dermoid cyst of the ovary coexisting with squamous-celled carcinoma of the cervix uteri, the latter extending out into the broad ligaments and to the tubes, not, however, involving the dermoid cyst. The combination of carcinoma and dermoid in the same tumor in any manner is rare, and carcinoma developed primarily from epithelial structures in a dermoid is very seldom seen.

In discussing the relations of carcinoma to dermoid cyst it is necessary to bear in mind the various possibilities, which are: First, a carcinomatous degeneration of the dermoid tumor itself; second, the carcinomatous degeneration of part of an ovary, another part of which contains a dermoid cyst; third, the original association of a multilocular cyst with a dermoid cyst, followed by a carcinomatous degeneration of the multilocular tumor, (Gessner), and fourth, the possibility of a dermoid cyst of the ovary being invaded by carcinoma from some contiguous organ.

The first case to be described in this report is one of carcinomatous degeneration of an ovarian dermoid cyst. Dr. Kel-

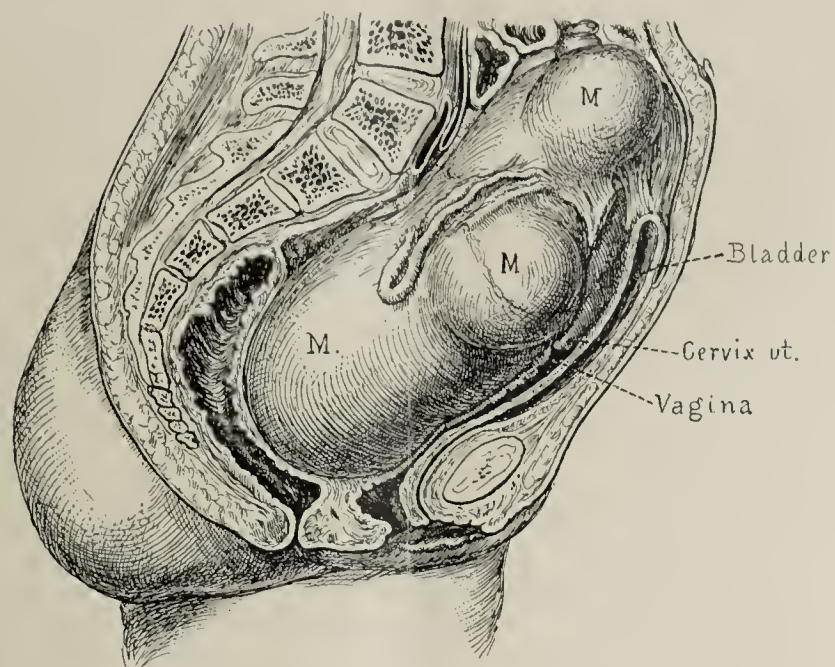


FIG. 1.—Shows the relations of the tumor to the rectum, bladder, and symphysis pubis and its extension into the endometrial sac.

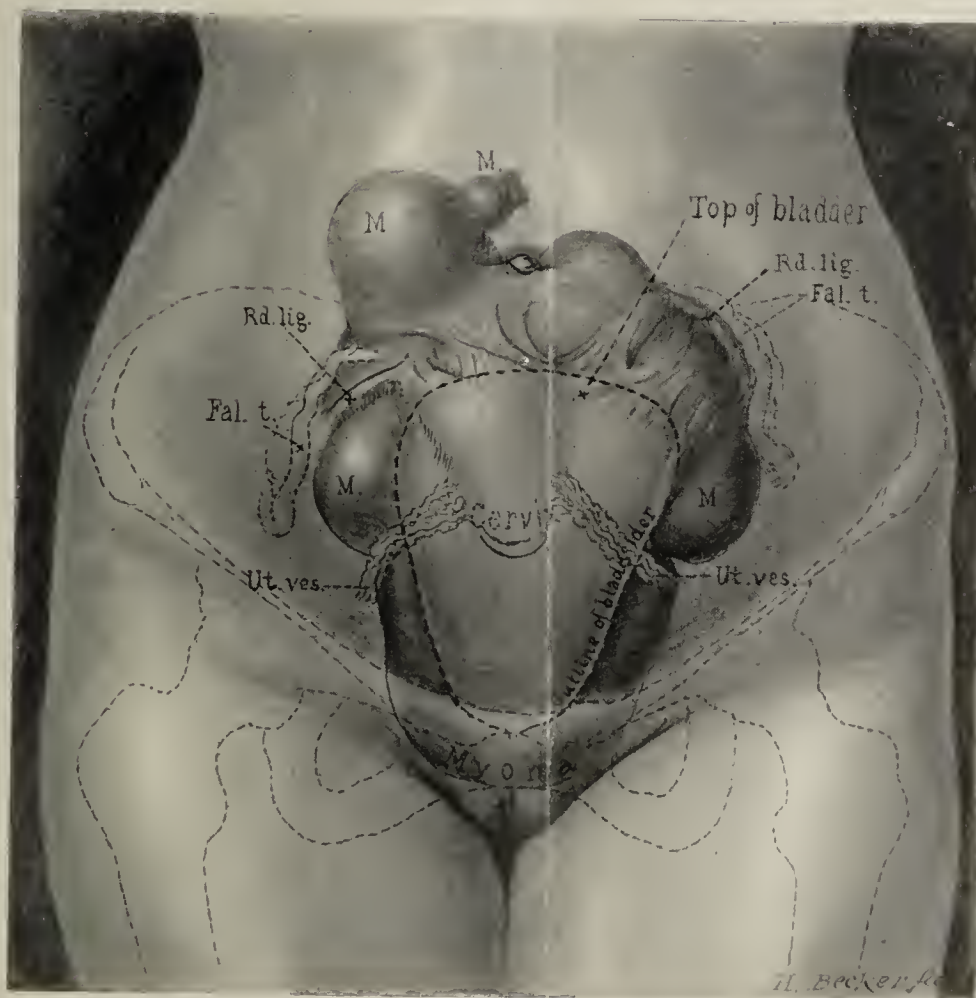


FIG. 2.—Tumor as it would appear through the transparent abdominal wall, showing diagrammatically its relations to the surrounding structures. The relations of the bladder to the cervix and body of the uterus can be well seen.

has already reported this case briefly before the Medical Society of the Johns Hopkins Hospital,* and I shall, therefore, not dwell upon the points which he has brought out, but shall endeavor to add to what he has reported something of the subsequent history of the case, and a more detailed description of the pathological findings. I am indebted to Dr. Kelly for placing the case in my hands for thorough description and publication.

CASE I. (*Gynecological No. 7394*).—Mrs. H. T., white, aged 46 years, was admitted to the Johns Hopkins Hospital, Nov. 24, 1899. Complaint, "pain in bowels."

The patient has had 10 children, no miscarriages. There is nothing of interest in the history of her labors except that she had puerperal septicæmia after the birth of her 9th child, 14 years ago, and that the birth of her last child, 10 years ago, was induced at the 8th month on account of hæmorrhages which began in the 6th month of gestation and ceased soon after delivery.

Menstruation has always been regular and normal. The last menstruation before operation was on Nov. 4, 1899.

She has had slight leucorrhœa, from time to time, for many years.

Her family history is good, excepting that her mother died of heart disease.

Her past history is good.

The history of her present illness is as follows. Since the birth of her 9th child, 14 years ago, she has suffered with soreness in both inguinal regions, and with distressing bladder symptoms—an sensation of weight or pressure on the bladder and, at times, incontinence of urine, at other times prolonged and painful retention of urine. Seven or eight years ago she noticed for the first time a tumor low down in the left side of the abdomen. This was freely movable and changed its position whenever the patient assumed certain postures. She thinks that the tumor remained the same size from the time she first noticed it until about three months ago, when it seemed to rise and cause "knots" or "lumps" in the abdomen. About this same time (three months ago), having previously been able to go about and attend to her duties, she took to her bed on account of the severity of the bladder symptoms mentioned above, and has remained in bed ever since. For the last two weeks she has been unable to void urine, except a very little at a time, and that only while standing.

Physical examination on admission.—The patient is emaciated; her cheeks are sunken, the complexion is sallow, the eyes watery, the mucous membranes pale, the tongue clean.

The pulse is regular in force and rhythm, of fair volume, but rather low tension, 96 per minute. The vessel-wall is palpable. The lungs are negative.

The heart is also negative.

Vaginal examination.—The external genitalia are normally developed, but somewhat atrophic. The vaginal outlet is markedly relaxed. The posterior vaginal wall presents at the vulval orifice over an area of about one square inch. The cervix cannot be distinctly outlined, but is apparently pushed upward an inch or so above the upper border of the symphysis, and to the right side. Here a small polyp can be felt. Filling the whole of the pelvis and extending to within $1\frac{1}{2}$ in. of the vulval orifice, pushing forward the posterior vaginal wall, is a tumor mass. This is in places hard and firm, in other places fluctuant. It is apparently firmly fixed in the pelvis, especially on the right side. The rectum is pushed well to the left side of the pelvis and its lumen encroached upon by the mass. The uterus is apparently situated upon the anterior face of the tumor, its fundus being about 10 to 12 cm. above the upper border of the symphysis. The

bladder is greatly distended, extending to the top of this mass which we consider to be the uterus. During examination urine passes freely from the meatus. The tumor, which apparently springs from the right side of the pelvis, extends to the umbilicus above. It is irregular in outline, somewhat nodular. It is fluctuant and tense over most of its surface and is apparently firmly fixed in the pelvis. Slight crepitation can be felt over the left anterior surface of the tumor.

Operation (Cystectomy by Dr. Kelly).—A median incision, 18 cm. long, was made, exposing the uterus flattened against the anterior abdominal wall. Several small, hard nodules in the bladder peritoneum were excised, and others were seen over the peritoneal surface. The tumor was densely adherent to the sigmoid, rectum and pelvic walls. A large leash of blood-vessels running in the infundibulo-pelvic ligament on the left were ligated and cut. The tumor contents (dermoid) were drawn off by a large trocar. The peritoneal coat of the tumor was incised and the tumor-wall separated, by blunt dissection along the surface of cleavage, from its adhesions to the intestines, pelvis, etc. There was moderate oozing until, on detaching the tumor from the rectum and vagina, low down on the posterior wall of the pelvis, near the anus, a carcinomatous mass was encountered, which bled freely and was curetted away. After curettage, removing about 12 cc. of friable material, resembling an advanced cervical cancer, an opening into the posterior vaginal vault was made with the end of blunt forceps and stretched the full width of the vagina for drainage. Washed-out iodoform gauze was laid in the pelvis and brought out into the vagina. The question then was, how to protect this cancerous area, sure to break down immediately, from the peritoneal cavity above. This was done by taking the large, somewhat plastic uterine body, with its right tube and ovary amputated, but with the left tube and ovary intact, and drawing it back into retroflexion, when it snugly and exactly filled the opening at the pelvic brim. The uterus was then sewed to the brim of the pelvis by continuous catgut suture, beginning with the right round ligament and suturing it for about 2 cm. to the brim and then continuing on around the fundus on a line between the tubal ends, anterior to the amputated surface on the right, over to the opposite tube and ovary and beneath them, leaving them projecting up into the abdominal cavity. The rectum was protected from sutures by a thick fold of membrane left from the capsule of the tumor. After extirpation, the rectum just had snug room at the brim of the pelvis. The left round ligament was not sutured, as the suturing ended with the infundibulo-pelvic ligament. Several bleeding points on the sac-wall were ligated. The abdomen was flushed out with normal salt solution and closed with interrupted silk-worm-gut and catgut sutures.

DESCRIPTION OF THE TUMOR.—*Gynecological-pathological No. 3647.*

Gross description.—The specimen consists of a cyst, a Fallopian tube and numerous small scraps of tissue of irregular shapes, which were removed by curettage from the posterior wall of the pelvis.

The cyst is 13 cm. in diameter. Exteriorly it is pinkish-yellow in color and for the most part smooth, though in places, especially towards the base, dense adhesions are seen. Also near the base, on the right, postero-inferior portion of the outer surface, is a circular, rough excrescence, about 5 cm. in diameter and raised about 5 to 7 mm. above the surrounding surface. This is composed of pale-pink, somewhat hard, coarsely granular tissue, some parts of which are quite friable, other parts firmly held together by a stout fibrous

* Philadelphia Med. Journ., 1899, Vol. IV, No. 36, p. 1208.

network. At about the centre of this circular area there is a small opening, 5 mm. in diameter, into the cyst-cavity, apparently made by tearing of the cyst-wall in removal of the tumor. There is another small opening, about 2.5 cm. long, in the upper wall of the cyst, made during the operation for the purpose of evacuating the contained fluid. The thickness of the wall varies from 1 to 4 mm., except in one part of the cyst near its base, where long, high, narrow ridges of tissue, to which wisps of long, fine, blonde hair are attached, project into the cyst-cavity. The thickness of these ridges from side to side varies from .5 to 1 cm. They rise from 1 to 2.5 cm. above the surrounding surface and are from 2 to 4 cm. long. The wisps of hair are matted together by a large amount of greasy, sebaceous secretion. In the wall, beneath the base of the highest of the ridges of tissue just described, there is found a mass of hard bone, about 2 cm. in its greatest diameter, of very irregular shape. There are also, on various parts of the inner surface, smooth, slightly elevated ridges which represent the remains of previously existing septa. The remainder of the inner surface has a puckered or rugous appearance and, in general, is of an opaque, yellowish-white color. But there are numerous areas from 3 mm. to 2 cm. in diameter which are very slightly (scarcely .5 mm.) elevated, of a reddish-brown color and have sharply defined, circular or irregular outlines. They have a somewhat velvety appearance owing to numerous minute, columnar and papilla-like projections of which they are composed. The inner surface of the cyst opposite the rough, circular area on the outer surface is comparatively smooth, except immediately around the small opening at the centre of the rough area, where there is a border about 2 to 3 mm. in diameter, composed of slightly raised, coarsely granular tissue.

The Fallopian tube is 5.5 cm. long, having a practically uniform diameter of 6 mm. It is enveloped by dense adhesions. The fimbriae are matted together, the ostium abdominale occluded. Just below the tube, between the layers of the broad ligament, 1 cm. from its outer extremity, are three small, thin-walled, translucent cysts, side by side, 3 to 5 mm. in diameter.

The irregular pieces of tissue removed by curettage are firm in consistency, dark red in color, for the most part very friable, and have many slender projections on their surfaces. They vary from 1 to 2.5 cm. in greatest diameter.

With the exception of the scraps of tissue removed by curettage from the posterior wall of the pelvis, which were preserved in a 5 per cent solution of formalin, the gross specimen was preserved in Müller's fluid and afterwards washed in running water, then placed in 95 per cent alcohol. Sections were cut for microscopic study from (a) the ridges of tissue from which the wisps of hair took origin; (b) various parts of the wall, not including the rough excrescence on the outer surface; (c) the portion of the wall occupied by the rough excrescence; (d) from the scraps of tissue curetted from the posterior wall of the pelvis; (e) from the Fallopian tube. These, after being properly hardened by the usual method, were embedded in celloidin. Microtome sections were then cut and were stained with hæmatoxylin and eosin.

Microscopic description. (a). Sections through the ridges

of tissue from which the wisps of hair took origin are seen to have very uneven surfaces, presenting alternate, irregular projections and depressions. Upon the surface is a layer of stratified squamous epithelial cells, which varies from 2 or 3 to 6 or 7 cells in thickness. The most superficial of these epithelial cells have degenerated and have been cast off from the surface either singly or in homogeneous, deeply eosin-stained bands formed by the coalescence of the superficial cells. Definite prickle-cells are seen in the deepest stratum of the layer. In many places the epithelium covering the surface is degenerated throughout the thickness of the layer being converted into a mass of refractile, disintegrated, deeply eosin-stained tissue. In the stroma beneath the layer of surface epithelium there are many cross and oblique sections of hair follicles and numerous normal sebaceous and sudoriferous glands. Some of the hair follicles contain hairs, others do not. The stroma is composed of dense, wavy fibrous tissue poor in nuclei, and running through it are many thin-walled blood-vessels. There are also many masses of colored blood corpuscles in the stroma, some of which are free in the tissue, others contained in the walls of congested blood-vessels. The tissues, in many places, show beginning hyaline change. Scattered through all the tissues of the wall are fairly numerous small round cells and a few polymorphonuclear leucocytes. The degree of the leucocytic invasion varies very much in different parts of the specimens, being quite dense in many places near the inner surface.

(b). On examining many sections from various parts of the wall (not including the rough excrescence on the outer surface), it is found to be composed for the most part of dense fibrous tissue which, in many places, shows hyaline degeneration. In a few places, small bundles of non-striated muscle fibres are seen. The fibrous tissue is densest next to the outer surface, where, in some places, its appearance is suggestive of ovarian stroma. The outer surface is generally smooth and even, but here and there thick, non-vascular tags of adhesions are seen. There are also a few slit-like spaces just beneath the outer surface lined by a single layer of flattened, endothelial cells. Blood-vessels of considerable size are scattered in moderate abundance through all parts of the wall.

The inner surface is, for the most part, devoid of any epithelial lining, although in some places it is covered by layers of stratified epithelium from 2 or 3 to 15 or 20 cells in thickness. The cells in the thickest layers are, in general, flattened from side to side instead of from above downward, in the stratified squamous epithelium of normal structure such as the cervix uteri, vagina, skin, etc. In the thinner layers they are flattened from above downward, and in the layers intermediate in thickness they are much less compressed, *i. e.*, more polyhedral in form. Some of the cells in the deepest strata are prickle-cells. No definite papillae are formed beneath the epithelium. The portions of the inner surface not covered by epithelium are wavy in outline and are composed of fibrous tissue, which, in many places, resembles chronic granulation-tissue, containing many very small, well-formed, congested blood-vessels. The tissues, a short distance below the surface, are permeated by extravasated blood. The reddish-brown, slightly elevated areas on the inner

surface, noted in the macroscopic description, are seen in the microscopic specimens to have very uneven surfaces, presenting many irregular depressions and processes. They are composed of loosely disposed cells, which are exceedingly multifarious in size and structure. Some of the cells are of moderate size, polyhedral in shape, containing single, spherical or oval nuclei, which stain homogeneously. There are a few elongate cells with spindle-shaped nuclei, but the most conspicuous feature in the tissues of these areas is the presence of immense giant-cells, some of which occur in groups of from 2 to 5, and appear to be partly fused with one another. They are seen sometimes on the surface, sometimes a short distance below it. Each giant-cell contains from 3 or 4 to 40 or 50 small spherical nuclei, which are grouped round the periphery in some of the cells, towards the centre in others. Numerous minute blood-vessels, many of them engorged with blood, run in and out among the cells, and in the interstices of the tissue are large numbers of small round cells, polymorphonuclear leucocytes and colored blood-corpuscles. The protoplasm of the cells containing single nuclei, as well as that of the giant-cells, is deeply stained with eosin, and has an homogeneous, cloudy, blurred appearance, the outlines of the cells being as a rule ill-defined. The deepest portion of this tissue is continuous with underlying hæmorrhagic areas in the cyst-wall. Its cells show no evidence of abnormally active proliferation, nor any tendency to strike downward into the subjacent tissues.

(c). Sections through the part of the wall occupied by the circular excrescence on the right, postero-inferior portion of the outer surface have the following appearances:

The distance from the inner to the outer surface in the sections varies from .5 to 1 cm. The outer portions of the wall are composed mostly of masses of epithelial cells. These masses are very irregular in shape, of various sizes, and are separated from one another by dense fibrous stroma. The epithelial cells in the masses are very variable in form and size, the average-sized cells being about as large as the cells seen in the stratum granulosum of the skin. In general, the cells on and near the margins of the masses are smaller, more closely packed together, and contain more deeply stained nuclei than the cells nearer the centres of the masses. The cells near the central portions of the masses are very large and their nuclei are somewhat more palely stained than those near the margins. All of the nuclei vary greatly in intensity of staining. They also, like their containing cells, are very variable in size, some of them being as much as 5 or 6 times larger than the average-sized nucleus. They are, as a rule, spherical or ovoid in shape, consisting of an outer, narrow, homogeneous, pellucid, lightly hæmatoxylin-stained rim or capsule and a large, central mass of coarse, highly refractile, deeply hæmatoxylin-stained granules, in a few of them a central, spherical or ovoid nucleolus being seen. The protoplasm of the cells is finely granular and stains deeply with eosin. In some places, where the outlines of the cells are distinctly seen, prickles are observed around the margins of the cells. There are many large, necrotic areas in which no cellular elements are

found. Small areas of necrosis are often seen in the central portions of the epithelial masses.

The masses of epithelial cells just described have the arrangement and other characteristics of carcinoma; they are, in fact, "carcinoma cell-nests." The new growth, although involving chiefly the outer layers of the cyst-wall, is found (in sections through the wall made in such a way as to include the rough margins of the small opening on the inner surface, opposite the centre of the circular excrescence on the outer surface) to extend through the entire thickness of the wall, in one place a transition from the lining epithelium into the carcinomatous tissue being seen. The only carcinomatous portion of the inner surface is that covered by the rough margins of the small opening opposite the centre of the excrescence on the outer surface. The carcinomatous tissue is seen undermining the lining epithelium as well as growing downward from the inner surface. The growth spreads more and more laterally as it approaches the outer surface.

The portions of the sections not invaded by the carcinoma are composed of dense fibrous tissue. All of the tissues are diffusely infiltrated with leucocytes—chiefly polymorphonuclear. The infiltration is most marked in the fibrous stroma around the cell-nests.

In these sections no karyokinetic figures are found. There are, however, a considerable number of tumor-cells, in each of which a pair of nuclei is seen. Each nucleus in every pair has the form of one-half of an ovoid which has been divided at a right angle to its long axis, the divided ends facing each other and being almost, if not quite, in contact. Except for their form and their position relative to each other, these twin nuclei do not differ in appearance from the nuclei of the tumor-cells in general, nor is any difference between the appearance of the protoplasm of the cells containing the twin nuclei and that of the cells containing single nuclei detected. In addition to the twin nuclei, one occasionally sees a nucleus with a faint, indefinite, light line running across its middle. Some cells are found in which there are three distinct, well-formed nuclei, which are closely adjacent to one another, their adjacent edges being flattened as if from pressure against one another, and a few cells are seen in which there are indistinct lines of cleavage (?) in each nucleus, dividing it into four parts. Still another type of cell is seen which is always mononuclear and is noteworthy, not on account of any peculiarity of its nucleus, but because there are light lines radiating from the margins of the nucleus through the protoplasm to the borders of the cell-wall. These cells are always nearly exactly circular in outline, and their protoplasm stains deeply with eosin in a narrow zone immediately around the nucleus, from which the color gradually shades into a very pale pink at the margins of the cell.

Occasionally one finds a group of cells arranged in concentric layers around a central cell, all the cells in the layers being flattened towards the centre of the group. They have the appearance of "carcinoma pearls" in an early stage of formation.

(d). In the sections from the scraps of tissue curetted

away from the posterior wall of the pelvis, the same tissue-elements are found as were described for the outer part of the wall in the third group of sections (*c*), and the tissues have the same general arrangement into epithelial masses surrounded by dense fibrous stroma. The epithelial cells, however, differ from those described under group (*c*) in the following respects: the former have a smaller average size than the latter, their protoplasm stains a faint pinkish-violet color instead of taking an intense eosin stain and their nuclei, instead of being composed of coarse granules are vesicular, having very thin walls containing fine, loosely scattered granules of chromatin. Many of the cells in these sections contain karyokinetic figures showing various stages of indirect cell-division, some of the figures being symmetrical, others asymmetrical. Also many cells are found containing 2 or sometimes 3 well-formed nuclei within a single cell-wall which shows no evidence of beginning division. All of the tissues are diffusely infiltrated with polymorphonuclear leucocytes and small round cells, the infiltration being most marked in the fibrous trabeculae between the epithelial masses. There is no suggestion of a glandular arrangement of the cells.

(*e*). The folds of the mucosa of the tube are normal in size and are not adherent to one another. They are covered by a single layer of normal, low-columnar, ciliated epithelial cells, which contain spherical or oval, evenly stained nuclei. The stroma of the folds has the normal appearance and is free from leucocytic infiltration. The muscular coats are atrophied, appearing in small, scattered strands of non-striated muscle-fibres just exterior to the tubal mucosa. Between the scattered strands of muscle-fibres is dense, wavy, fibrous tissue, poor in nuclei. The outline of the outer surface is generally slightly wavy and is partly covered by small cells, in a single layer, which have large, oval nuclei, flattened from above downward, which almost completely fill the cells. These are endothelial cells of the peritoneum. There are a few tags of old, slightly vascular, fibrous adhesions projecting from the outer surface.

DEDUCTIONS FROM DESCRIPTION OF SPECIMEN.—From the above description it is evident that we are dealing with a squamous-celled carcinomatous growth in the wall of a dermoid cyst. As a transition from the lining epithelium of the cyst into the carcinoma is demonstrable in the microscopic specimens and, moreover, there being no discoverable carcinoma in any other part of the body, there can be no doubt that the origin of the growth was from the lining epithelium of the cyst. The fact that the growth at its point of origin covers such a small area and projects so slightly into the cavity of the cyst is remarkable, and we offer as an explanation thereof the suggestion that the pressure exerted by the contents of the tensely distended cyst may have prevented the growth of the tumor into the cavity.

Concerning the peculiar appearances in some of the tumor-cells noted in the description of group (*c*) of the microscopic specimens, it is impossible to arrive at any conclusions, the tumor not having been placed in the fixing fluid until several hours after its removal from the body. However, we think it possible that the appearances are due to changes in the cells which have taken place after extirpation of the tumor, the

nuclei in groups of 2, 3 and 4 being possibly the result of the completion of the cycle of division by nuclei which, at the time of removal of the tumor, had already begun to divide. The appearance of some of the multinuclear cells is, however, very suggestive of direct division of the nuclei.

The giant cells noted in the description of group (*b*) of the microscopic specimens have the same appearance as the giant cells which are often met with on the inner surfaces of dermoid cysts free from any malignant new growth. These have been described (Hildebrandt¹) as foreign-body giant-cells, supposed to be due to the presence of hairs in the walls of the cysts; but we have often observed them in parts of the walls of dermoid cysts in which there were no hairs to be seen and also in simple dermoids in which no hairs were found in any part either by macroscopic or microscopic examination; they are, therefore, as suggested by Cullen, more probably a form of embryonic epithelium from which the lining epithelium of the cysts is developed. In the case which we now have under consideration the giant-cells are found in parts of the tumor remote from the ridges of tissue to which alone the hairs were attached.* The tissue in which some of our giant cells are embedded is, in all probability, granulation tissue formed as a result of long-standing inflammation of and hæmorrhage into the tissues upon and immediately beneath the surface of the cyst-wall.

POST-OPERATIVE HISTORY.—The patient had practically no nausea after operation, but pain during the first 3 days was sufficiently severe to require morphia. During the 5th, 6th and 7th days the gauze drain in the pelvic cavity was gradually pulled out, a small piece of it being clipped off each day, until on the 8th day all that remained of the drain was removed, after which a considerable amount of sanguino-purulent fluid escaped. The cavity in the pelvis was then carefully cleansed by douching with a saturated solution of boracic acid and again filled with clean gauze. From this time on dilatation of the opening into the cavity and douching and repacking of the cavity were repeated every day. On the 9th day the abdominal wound was inspected and found to have healed perfectly. Alternate silkworm-gut suture were removed. On the 12th day all remaining sutures were removed from the abdominal incision, and the following note was made. "By examination with one finger in the cavity and another finger in the rectum, it is ascertained that the cavity lies entirely to the right of the rectum and is separate from it by a septum of firm, indurated tissue, about .5 cm thick, which extends upward (along the side of the rectum) to a point just within the reach of the examining finger. The lumen of the rectum is considerably encroached upon."

The patient was allowed to be out of bed in a wheel-chair on the 24th day, and was able to walk several days before her discharge from the hospital on the 36th day.

During the entire convalescence there was considerable

* Cullen says that in very early dermoids of the ovary, where the epithelium is as yet present and where no sebaceous nor sudoriparous glands are found, the diagnosis can be made, with almost absolute certainty, from these characteristic giant cells. (*Personal communication*).

inguino purulent discharge, which at times had an offensive odor. The patient complained repeatedly of pain in the right hip and back, chiefly at night. There was also, at times, severe pain in the rectum, which was, however, relieved by defecation.

During the first 3 days after operation the temperature chart showed a range of temperature between 100° and 101°F., the pulse ranging between 96 and 108 per minute. After this time the temperature continued very slightly above normal until the end of convalescence, except on the 19th and 24th days, when there were slight rises to 100.5°F. The pulse, after the 3rd day, ranged between 88 and 104 per minute. The following is a note made on the discharge of the patient from the hospital on the 36th day. "The cavity posterior to the vagina has decreased in size. It holds about two ounces. The new growth has increased markedly and extends down to the anal orifice. The opening into the cavity admits the index finger. The uterus is felt in adherent retroflexion. The patient's general condition is only fair; she suffers considerable pain in the hip and back; she also requires codeia at night for sleep, and suffers with constipation."

In a letter written thirteen weeks after operation, the patient states that she notices very little change in her general health since leaving the hospital, but that she now has a very offensive discharge, "like decayed blood," from the tumor. It is, therefore, highly probable that the carcinoma is now extended through the rectal wall. The fact that the patient is still alive and notices very little change in her condition, except that which can be explained by local extension of the growth, shows that the efforts to protect the abdominal cavity by suturing the uterus to the pelvic brim have been successful.

REVIEW OF THE LITERATURE.—The first indubitable case of carcinoma developed from epithelial elements of a dermoid is that reported by Bierman,² in 1885. Before that time other cases had been published by Heschl,³ von Wahl,⁴ Cohn,⁵ Wit and Pomorski,⁷ in which carcinoma and dermoid cysts were said to be associated in the same tumor; but none of these will be discussed, some of them being too inadequately reported to establish their authenticity, others undoubtedly deserving to be considered as "mixed tumors" and not as dermoid cysts which have undergone carcinomatous degeneration. In 1884, Babinski⁶ reported two cases which he considered to be carcinoma "probably" derived from dermoid cysts, but his descriptions are meagre and his conclusions are uncertain. After the publication of Bierman's case, Himmelstein,⁸ in 1886, Krukenberg,¹⁰ in 1887, and Tauffer,¹¹ in 1895, each reported an authentic case of squamous-celled carcinomatous degeneration of a dermoid cyst. In 1897, two other cases were published, one by Thumin,¹² another by Yamagiwa.¹³ Clark,¹⁴ while working in the laboratory of Chiari, at Prag, published, in 1898, the case of a dermoid cyst which had been discovered among a large collection of museum specimens and which proved, on microscopical examination, to have undergone carcinomatous change in one part. The tumor had been extirpated by abdominal section, in May, 1885, from a woman aged 29 years. At the same operation a metastatic nodule the size of a walnut was removed from the left axilla.

The patient made a good recovery from the operation, but no further history was obtainable. Clark was able to trace, in the microscopic specimens, a transition from the normal epithelial lining of the cyst into the carcinomatous tissue. He also described giant-cells similar to those which we have noted in our case. Tauffer gives very full abstracts from the descriptions of the cases of von Wahl, Heschl, Bierman, Himmelfarb and Krukenberg, and Clark also gives a very satisfactory summary of all the cases published prior to his own.

Since the report of Clark's case, we find only one other observation of carcinomatous degeneration of a dermoid cyst of the ovary, that reported by Lockhart and Anderson,¹⁵ in 1899. In their case the patient was an unmarried woman, 50 years of age. At operation, the tumor was punctured and "120 ounces of thick, grumous fluid, containing caseous material and hair," escaped, revealing the dermoid nature of the tumor. It was learned that the tumor had originated in the left ovary, and that its pedicle, consisting of the uterus and broad ligament, was twisted half way around. Many dense adhesions of the cyst to the upper part of the left wall of the abdomen, to the omentum, to the under surface of the right lobe of the liver, to the right anterior abdominal wall and to the intestines, were encountered. The patient did well for the first four weeks after operation, and was discharged from the hospital on the 31st day, but died one week later. The tumor is described as a "large, irregular-shaped mass, measuring 18 x 15 x 14 cm., weighing 1,570 grms." Its peritoneal covering was "thickened and hæmorrhagic." On section it was found to be composed of a "series of large cysts whose walls were markedly thickened, in some places measuring 5 cm." The cyst contained a "thick, oily, flocculent fluid, as well as two large, rounded masses of hair, about the size of large apples." Three teeth, embedded in the wall and projecting into the cyst-cavity, were also found. The following is a copy, in full, of the description of the microscopic specimens: "The tumor is seen to be composed mainly of epithelial elements, which infiltrate extensively the fibrous tissue stroma. Multiple pearl-nests are found in these areas. At other points the epithelial cells are arranged in alveolar and tubular forms, as in carcinoma, with large bands of fibrous tissue surrounding them. A large amount of adipose tissue is also present. The vessels throughout are numerous, and engorged with blood, and in places surrounding these are a large number of small, round cells." They then conclude:

"The tumor is, therefore, an ovarian dermoid cyst, with epitheliomatous, and, in some places, carcinomatous infiltrations. It also shows evidences of acute, and, in some places, sub-acute inflammatory reaction."

Cone,¹⁶ in 1897, described a dermoid of the lower jaw which showed squamous-celled carcinomatous degeneration, and referred to similar cases observed by Franke, Czerny and Briddon. Cone also noted in his case the presence of giant-cells. These were of two kinds, one of which were found around the roots of hairs and thought to be "foreign-body giant-cells," the other kind being seen in the centres of typical tubercles and considered as "tubercle giant-cells."

In 1897, Yamagiwa published, with his case, which we have

already alluded to, another case which he believed to be one of adenocarcinoma, developed from a nipple-like growth or anomalous, misplaced mammary gland on the inner surface of the dermoid cyst. That is the only case of adenocarcinomatous degeneration of a dermoid of which we are able to obtain record.

As yet, no case of carcinoma, thought to be derived from the sudoriparous or sebaceous glands of a dermoid cyst, has been reported.

The secondary changes, other than carcinomatous, which have been observed in dermoid cysts, are rather limited in variety. Friedländer¹⁷ has reported an instance of cystic degeneration of glands in the wall of a dermoid, Bierman¹⁸ an instance of primary sarcoma and Faquet¹⁹ an instance of endothelioma in a dermoid. Papillary growths in multilocular ovarian cysts, which were only partly dermoid, have also been reported.

The remaining case which we have to report is interesting as an example of the second class of possibilities which we have mentioned, *i. e.*, a carcinomatous degeneration of a part of an ovary, another part of which contains a dermoid cyst. On looking through the literature we do not find any similar case previously reported.

CASE II. (*Gynecological No.* 5164.)—Mrs. K., white, aged 36 years, was admitted to The Johns Hopkins Hospital, April 6, 1897.

The patient has had 6 children and 1 miscarriage. Puerperal fever followed her last confinement, six years ago, and at the same time she had "milk leg," affecting the right lower extremity.

Her menses began at 16 years. They are always regular and last 3 to 4 days.

She had profuse and offensive leucorrhœa for two years after the birth of her last child.

Two uncles died of phthisis. The family history is otherwise negative.

The patient has had only the usual diseases of childhood, and has always been strong and well.

Her present illness began in August, 1896, with fever which her doctor pronounced typhoid. She was in bed two weeks and since then has had fever "off and on," and at recent menstrual periods has suffered exquisite pain in the left ovarian region, with great nausea and vomiting.

Operation (Double Cystectomy, with removal of the uterus, by Dr. Kelly).—The right ovary is found converted into a lobulated and nodular tumor about 10 cm. in diameter. This is slightly bound down by adhesions, and at its inner and upper pole is a subperitoneal cyst, 4 cm. in diameter.

Enucleation was commenced on the right side on account of adhesions of the left ovary, which was twice the normal size and was occupied by a growth similar to that on the right. The uterus was amputated at the cervix, and the operation was then completed in the usual way. Small, secondary nodules were seen in the omentum.

Over the region of the left kidney there was a lobulated, nodular mass about 8 x 7 cm. This was probably infiltrated omentum.

The abdomen was washed out with salt solution. In closing the wound, catgut was used for the peritoneum, and interrupted, through-and-through silkworm-gut and catgut for the other layers.

DESCRIPTION OF THE SPECIMEN. *Gynecological-pathological No.* 1645.

Gross description.—The uterus measures 6.5 x 4.5 cm. The posterior surface and fundus are covered by adhesions. On section the uterine cavity is seen to be 4 cm. long, and 4 cm. broad at its fundus. The uterine mucosa is pale and looks œdematous. In the cervix is a dilated follicle 4 mm. in diameter.

Right side.—The ovarian tumor, which resembles a cystic kidney in contour, measures 10 x 5.5 x 4 cm. The surface is nodular, and on one side is a bunch of 8 or 9 cystic or partly solid nodules, some of which resemble hæmorrhagic Graafian follicles, others contain clear fluid. On section, the tumor is found to be of a yellowish color and to consist of a somewhat friable, homogeneous or fibrillated tissue, which here and there, around the periphery, presents small cystic areas into some of which hæmorrhage has occurred. In the hilum of the tumor is a cyst 2.5 x 1.5 cm. which contains a buttery material resembling dermoid contents.

The Fallopian tube is bound down to the surface of the tumor, but is apparently patent.

Left side.—The ovary is converted into a small, nodular tumor, 4 x 3 cm., resembling the one on the opposite side. On its upper surface, at the inner pole, is a corpus luteum 1 cm. in diameter.

Microscopic examination.—The uterine mucosa has an intact surface epithelium. The glands are abundant and few slightly dilated. Frequently a gland is seen extending a short distance into the muscular coat, but the glands are perfectly normal. The stroma of the mucosa is rarefied.

Right side.—The ovarian elements are almost entirely replaced by neoplastic tissue. This consists of narrow branching processes of epithelium penetrating the stroma in all directions. These processes often consist of but two rows of cells, which may present a narrow central lumen. Frequently, however, the cells form solid cylinders, sometimes of considerable thickness. On cross-section, solid nests of epithelial cells are found or a minute cavity, lined by one layer of cells. The individual cells vary in size and form, but are usually large, oval or cuboidal, and contain large, round, oval, crescentic or irregular nuclei, which in general take an intense, solid stain. Nuclear figures, both symmetrical and asymmetrical, are abundant, and there is slight karyorhexis, but, on the whole, nuclear fragmentation is not notable, and cell degeneration of all kinds is practically absent. The cell-masses are separated from one another by delicate strands of connective tissue, but the tumor is further irregularly divided into lobules by broad bands of connective tissue, and by practically unaltered ovarian stroma, which in some portions, especially around the periphery of the tumor, is present in considerable amount, though in every part showing, here and there, small epithelial masses.

The cystic portions appear to have originated in Graafian follicles or degenerated corpora fibrosa. In one section corpus fibrosum is found. Scattered through the stroma are a moderate number of small round cells. The vascularity of the tumor is moderate, the vessels usually of small size.

The cyst found in the hilum of the tumor presents the usual appearances of a simple dermoid. It is lined by stratified squamous epithelium, and in its wall are a few sebaceous

glands. No hair follicles are seen. For the most part the cyst is surrounded by a narrow band of connective tissue or ovarian stroma, but at some points the epithelial cells have penetrated to the surface and cell-masses are found in the mesosalpinx and even between the layers of muscle-bundles in the tube-wall. The broad ligament also contains metastases, cell-nests being found in the lymph-spaces, and, in one place, in a large vein. The tubal mucosa is normal and no tumor elements are found on the upper surface of the tube-wall.

Left side.—The tumor is similar to that on the opposite side. The corpus luteum observed macroscopically presents the usual features and shows commencing organization.

DIAGNOSIS.—Carcinoma ovarii duplex associated with a small dermoid cyst in the right ovary. Corpus luteum in the left ovary. Practically normal uterine mucosa. Perioophoritis. Subperitoneal cysts.

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PULMONARY TUBERCULOSIS, WITH DIFFUSE PNEUMONIC CONSOLIDATION, IN A LION.

BY W. G. MACCALLUM, M. D., AND A. W. CLEMENT, V. S., *Baltimore, Md.*

While in Birmingham, Ala., in November, 1899, one of the lions belonging to the Hagenbeck menagerie, a large adult male of the black-maned sort, which had been captured in South Africa and had been in captivity ten years, fell ill. The keeper noticed that the lion was not well and frequently refused food. On the removal of the menagerie to Baltimore he grew worse, developed a slight grunting cough, became very much thinner than normal, and, after an illness of about four weeks altogether, died.

The *autopsy* was performed the next day. The body was that of an adult male lion, said by the keeper to be about fourteen years old. The subcutaneous and omental fat were very much wasted. There was no accumulation of fluid in either peritoneal or pleural cavities, and the peritoneal surfaces at least were smooth and glistening.

For the sake of brevity, the description of the heart and abdominal viscera will be omitted, as they were apparently quite normal. The lungs appeared somewhat collapsed, and seemed to contain much less air than normal. Their pleural surfaces were not quite smooth, but had lost their gloss. There were, however, no adhesions between the layers. The left lung, which consisted of three lobes, was found to contain very little air, small portions of the upper lobe only being sufflated; the middle and lower lobes were quite solid. On cutting through the lung, the cut surface of the upper lobe presented, in general, a translucent appearance, being densely studded with small translucent nodules which projected from the surrounding surface; these hardly exceeded a pin-head in size, and never showed any central area of necrosis. The

intervening lung-substance was gray or grayish-yellow, and somewhat gelatinous and translucent. The lower lobes were more firmly and uniformly consolidated, the firmness being due to a diffuse consolidation rather than to the translucent nodules which were more sparsely scattered throughout these lobes. The cut surface was, as in the upper lobe, grayish-yellow and somewhat translucent. In the posterior portion of the lobe, there were two well-defined cavities communicating with one another by a narrow channel, and marked off from the surrounding lung by the fibrous thickening of their walls. These cavities communicated with the bronchi; their walls were fairly smooth and covered with a purulent material. Obliterated arteries crossed from side to side.

The right lung was much more voluminous than the left, the upper lobe being insufflated and containing only a few of the translucent nodules described. The lower lobes, as in the left lung, were consolidated. They were riddled with tubular cavities, which correspond with the bronchi, and which, for the most part, were filled with a yellowish purulent material.

The bronchial glands were slightly enlarged and deeply pigmented, but showed no areas of caseation.

Hardened sections of the upper lobes of the lung show the presence of small areas of consolidation here and there. These consist of rounded or oval tubercle-like masses of cells, sometimes close to the bronchi but more often in relation with the small blood-vessels. They are not entirely without a blood supply, for minute blood-vessels may be seen in their interior. They are made up for the most part of epithelioid cells, with vesicular nuclei arranged in an irregularly concentric manner,

often about several centres. There are very few lymphoid cells, but a considerable number of cells resembling polymorphonuclear leucocytes; and these, with the epithelioid cells, which are often much distorted and of bizarre form, make up the nodule. Very rarely is there any central giant-cell. These nodules are often very sharply outlined on account of the fact that they may fill an alveolus without disturbing the epithelium of the adjacent alveoli. The alveoli adjacent to the tubercles contain a gelatinous exudate consisting almost entirely of coagulated fluid and desquamated epithelial cells. There are a few polymorphonuclear leucocytes, but scarcely any fibrin; occasionally a little is shown by Weigert's fibrin stain.

Sections of the lower lobes show a great increase in the connective tissue throughout the lung, associated with the tubercle nodules, which are here much conglomerated. Giant-cells are seen in these matted tubercles, although so rare in the discrete nodules in the upper lobes. The alveoli of the intervening substance are completely obliterated by the fibrous tissue which is often much pigmented by coal-dust. In other portions of the lower lobes there are areas of gelatinous pneumonia, and also areas in which the walls of the alveoli, together with the exudate, have become completely necrotic and caseous.

The more densely consolidated portions often show definite bronchiectatic cavities, with thick fibrous walls and a content of cellular débris.

The giant-cells described above very commonly contain well-defined tubercle bacilli, as shown in sections stained by the method of Mallory. Stained by Weigert's method no other organisms can be demonstrated. Cultures from the lung were sterile, and two guinea-pigs, inoculated subcutaneously and intraperitoneally with emulsions of the lung substance, unfortunately died from intercurrent infections, so that no propagation of the organism was effected.

The demonstration of bacilli, identical in morphology with the tubercle bacilli in the giant-cells which formed the centres of nodules in the lung, morphologically like tubercles, seems conclusive enough evidence that the lesion was really tuberculosis of the lungs.

Sections of the other organs showed no tubercles and no other noticeable abnormality.

The exclusive localization of the process in the lungs is interesting in connection with the similar case reported by Straus,* in which, although there were large caseous masses in the lungs, there were no other viscera involved.

Straus' case is the only one in the literature which is

* Straus: Arch. de med. exper., 1894, VI, 645.

described in detail. Tuberculosis in lions does not seem extraordinarily uncommon, however, for Jensen mentions two cases, Haughton another, and Rayer, quoting Pirrault, two others. It is well known from the work of Jensen,* Eben,† Froehner,‡ Bollinger§ and others, that dogs and cats are more commonly subject to tuberculosis than is generally thought to be the case.

The localization of the tuberculous lesions in these more or less closely related animals is of interest in connection with this case. Dogs, as reported by these authors, most frequently suffer with pulmonary tuberculosis, and tuberculosis of the serous surfaces is with them more common than in cats, in which, while pulmonary tuberculosis predominates, lesions in the digestive organs are especially frequent.

It is not within the scope of this note to review the literature on tuberculosis in animals, of which good summaries are given by Nocard|| and Leray,** Rayer†† and others.

Lebert,‡‡ in writing of the tuberculosis of apes, states his opinion that they probably suffer in wild life as well as in menageries, and that they live no better in the tropical menageries than in the more northern ones. General opinion, however, seems to favor the view that confinement so lowers the resistance of wild animals, and especially those transported from tropical countries, as to predispose them to the invasion of the tubercle bacilli.

The most important result of a study of this case is apparently the evidence in favor of the view that a diffuse pneumonic consolidation can be caused by the tubercle bacillus alone. Cultures were sterile, and coverslips and sections showed no organisms except the tubercle bacilli, a condition not often found in the human lung, the seat of so extensive a change.

Whether the peculiarities of the bacilli, so much discussed of late,§§ or the differences in the tissues of the beasts, are to be given as the causes of the slight morphological differences in the tubercles in different animals, must be left undecided here.

* Jensen: J. comp. path and therap., 1891, IV, 103.

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ARSENICAL PIGMENTATION AND KERATOSIS.*

BY LOUIS P. HAMBURGER, M. D., *Assistant in Medicine, Johns Hopkins University.*

This patient, who has been kind enough to appear before the society to-night, is a clerk, forty-two years of age. He entered the Johns Hopkins Hospital Dispensary on the first of November 1899, complaining of swelling of the feet and abdomen. The family history is negative. As a child he had measles and scarlet fever. He has used neither alcohol nor tobacco. To that which is of importance in his past history I shall refer later. His illness began about eight months ago with a "cold" and a cough. About a month thereafter his abdomen began to swell, and he noted that at the end of the day's work his legs were swollen. The cough soon disappeared but the swelling of the abdomen continued. He has had no shortness of breath, nausea, "fainting spells" nor symptoms of weakness. His bowels have been regular. He presented about the same condition when I first saw him that he exhibits now. He is a sparely nourished man, the visible mucous membranes are of good color and present no unusual pigmentation. What immediately attracts one's attention is the condition of his skin. There is a more or less deep-brown discoloration over almost the entire body. The pigmentation as it appears over the abdomen may be taken as a type of this discoloration; differences in degree are presented by the skin in various localities. The skin in this situation is of a mottled yellowish-brown color; the mottling is due to small rounded areas of less pigmented, almost white skin, alternating with similar areas more deeply colored. Here and there are little dark, almost black, mole-like spots. The skin feels natural and at points a little scaly. The face is slightly involved; it is mottled, the complexion is muddy. On the neck, particularly at the back and the sides, the discoloration is marked, being less punctate and more diffuse than over the abdomen. Still more diffuse is the coloring of the axillary folds; they are uniformly colored a deep-brown. The punctate arrangement is resumed over the shoulders and arms, being more marked over the posterior and internal aspects of the limbs. The discoloration is slight over the forearm and practically absent over the hands. The chest and upper part of back are slightly involved; the areolæ, however, are of a dark chocolate-brown color. The abdomen and lower half of back are markedly pigmented. The inguinal folds, buttocks and internal aspects of the thighs are strikingly dark. Toward the lower thirds of the thighs the pigmentation fades; the skin of the legs is only mottled here and there with spots of pigment; the feet are free from the discoloration.

The skin of the hands is rough and dry. Over the palms it is diffusely thickened. Here, as well as over the dorsal

surfaces and between the fingers, are numerous small and large dirty-gray warts and callosities from the size of a pin-head to that of a pea. Some of them look like ordinary warts; others are smaller and more like little fine local thickenings. There is a "wart" on the ulnar border of the right wrist. The nails look natural. Projecting from the left elbow for a distance of about a centimetre is a curious conical wart-like thickening recalling somewhat the heaped-up scales of psoriasis.

The soles present even a more remarkable appearance than the palms. Here too is a diffuse thickening but particularly along the outer border, the heel and area corresponding to the metatarsophalangeal articulations. Over these parts and extending a little way up the posterior aspect of the heels there are numerous yellowish horny excrescences of all sizes, discrete and confluent. The nails are unaffected. From the anterior surface of right shoulder there projected a yellowish-brown, lobulated round wart. It was excised, and, examined microscopically, shows the structure of a papilloma.

Below each internal malleolus is a reddened scaly patch having a diameter of about a half centimetre. They bleed from minute points on removing the scales (psoriasis).

The lungs are clear. The point of the heart's maximum impulse is in the 5th l. i. s. in the nipple line. At this point as well as in the axilla a blowing systolic murmur is heard. The pulse is regular, 62 to the minute.

The abdomen was distended, bulging a little at the flanks. In these regions the percussion note was flat, but became tympanitic on one side when lying on the opposite.

The liver dulness began at the sixth rib in the right parasternal line. Palpation of the abdomen was unsatisfactory owing to the distention. The skin over the shins pitted a little on pressure. The urine contained neither albumin nor sugar.

Under a course of purgation the complaint for which he sought treatment has been a good deal relieved. The abdomen is not so distended, the feet are not so much swollen.

The cutaneous changes had come on so gradually that the patient had paid little attention to them. The warts had been annoying and he had had some of them removed from time to time.

When I saw this combination of extensive pigmentation and keratosis, I made inquiry at once as to the use of arsenic. The patient was much surprised by the question, replying that he had been taking Fowler's solution in doses of from five to eight drops three times daily off and on for a period of ten years. During this time he suffered from a cutaneous eruption which first appeared as a patch on the antero-external aspect of the right knee. It was red, dry and scaly. Other patches of varying sizes appeared from time to time over the body. The eruption itched, bled on scratching, and resembled the "spots" now present on the ankles. Arsenic was prescribed and the skin disease was benefited. After three or four weeks he would discontinue the use of Fowler's solution, only to resume it as a rule in another fortnight; at times because of the

* Presentation of the patient before the Johns Hopkins Hospital Medical Society, December 18, 1899.

[NOTE.—Since this paper has been in press my attention has been called to the excellent article by Dr. Hartzell on "Epithelioma as Sequel of Psoriasis and the Probability of its Arsenical Origin," which was published in the *Am. J. of Med. Sc.* of September, 1899. Some of the ground here independently traversed is covered by his contribution.—L. P. H.]

appearance of a fresh patch of eruption, often because of a fear of its return. Just when the present cutaneous manifestations made their appearance he does not know, but he is quite sure that it was subsequent to the use of arsenic.

To recapitulate: This man, suffering from some chronic cutaneous affection (probably psoriasis), began taking arsenic in the usual doses ten years ago and has continued its use off and on ever since. He took the last dose three weeks before his first visit to the dispensary. Then he had ascites and presented the cutaneous lesions which we have just considered.

It is more than probable that there is a causal relation between the ascites and the use of the arsenic. In this patient no other etiological factor is available. Mr. Hutchinson* has described a similar but more severe case in which paracentesis was performed on three occasions, complete recovery following only on discontinuing the drug. And in Geyer's report† on the endemic arsenicism of Reichenstein, due to the arsenical drinking water, several similar cases are quoted. However, it is not to this condition of our patient that I wish to call particular attention, but to the combination of widespread pigmentation and keratosis of the hands and feet. It is a clinical picture of prolonged arsenical medication. So characteristic is it that, in this case, the diagnosis can be made *de visu* without the assistance of the patient's statements.

It is right interesting to know how the relation between these dermatoses and the use of arsenic has been established. I shall begin with a consideration of the melanoderma.

Thomas Hunt is probably the first observer to call attention to arsenical pigmentation. In a communication on the administration of arsenic, published in 1847, he wrote: "The trunk of the patient first, and subsequently all those parts of the body which are by the dress protected from the access of light and air, become covered with a dirt-brown, dingy, unwashed appearance, which under a lens reveals a delicate desquamation of the epidermis, and is, in fact, a faint form of pityriasis."‡ He viewed this change as an effect of the drug's action.

In spite of this early account of arsenical melanoderma the condition was not generally recognized for many years thereafter. It was well known that any chronic inflammation of the skin might leave its mark in the shape of a pigmentation at the site of an old lesion. Hebra, in his well-known textbook, spoke of this fact in connection with cases of psoriasis, and particularly those treated with arsenic, recommending a reduction of the dose as soon as the pigmentation appears.§ No more definite statement regarding the relation between the arsenic and the discoloration is made. Before Hebra's book was published, Devergie had expressed the opinion that the pigmentation in such cases is in all probability due to the arsenic, and the term "taches arsenicales" is applied to the

discolored areas.* But this view was not so readily accepted, and discussion continued as to what share the disease took and what rôle the arsenic played in the causation of the melanoderma. In time, however, there accumulated many dermatological observations, in which the pigment was said to appear at points unaffected by the original cutaneous disease, so that there could be no doubt as to its arsenical or inflammatory origin. Finally, when clinicians began to report numbers of cases, chiefly of chorea and accidental poisonings where discoloration of the skin followed the ingestion of the drug, arsenical pigmentation was accepted as an established fact and came to take its place in the list of arsenical dermatoses.† That list is a long one; besides the eruptions which we are now considering, it includes representatives of all the elementary cutaneous lesions from the oedematous to the pustular. In this connection it is of interest to note that a certain chronological sequence in the appearance of these eruptions can be observed. Some represent an acute intoxication, as it were; others, a chronic. At one end of the series stands the oedema which may come on after a day or two's administration; at the other end are the melanosis and keratosis. As a rule, the melanosis appears after a period of some weeks or months of arsenical medication. It matters not what preparation of the drug is used; arsenious acid, sodium arseniate, Fowler's solution—all have caused it.

The localization of the discoloration, as our patient presents it, may be taken as typical. The pigment appears in small yellowish-brown maculæ, which coalescing may come to cover a large area of skin, giving to it a rather characteristic mottling. But it is not always characteristic enough to be distinguished from the bronzing of Addison's disease. Like the pigmentation of this disease, it is more intense in localities exposed to friction or where there is normally more or less pigment. In this patient you see how dark the axillary and inguinal folds and the areolæ are. Unlike the coloring of Addison's disease, the exposed parts do not tend to suffer, nor are the visible mucous membranes involved. The shade of the pigment does not help in the differentiation from "bronzed skin," for in both conditions all shades of brown may be represented. Indeed, a case of arsenical pigmentation has been reported in which the skin, from the groins to the toes, was "absolutely black."‡ When one considers that these patients may present the gastro-intestinal symptoms of arsenic poisoning, the differentiation between arsenical intoxication and Addison's disease becomes worthy of consideration. There is a case of so-called arsenical melanoderma on record which, by its subsequent course, proved to be an example of suparenal disease.§

The error might have been avoided had the pigmentation of the mucous membranes been rightly interpreted.

In phthisis and exophthalmic goitre pigmentation of the

* Archives of Surgery, 1895, Vol. VI, p. 389.

† Ueber die chronischen Hautveränderungen beim Arsenicismus u. Betrachtungen über d. Massenerkrankungen in Reichenstein. Arch. f. Derm. u. Syph., 1898, Bd. 43, S. 221.

‡ Further observations on the administration of arsenic. Lancet, 1847, I, p. 92.

§ Lehrb. d. Hautkrankh., 1874, 2 Aufl., S. 345.

* Traité pratique des Maladies de la Peau, 1857, p. 137.

† For literature, see Geyer, loc. cit.

‡ Barthelemy: quoted by Rasch, Contribution à l'étude des dermatoses d'origine arsenicale, Ann. de Derm. et de Syph., 1893, t. IV, p. 160.

§ Audry, Ann. de Derm. et de Syph., 1896, t. VII, p. 1415. For "note rectificative," see tome IX, 1898, p. 538.

in is sometimes seen. It is possible, as has been suggested, that in some of these cases the discoloration may have an arsenical origin, for in both diseases arsenic is often administered for long periods of time.

What are the minute changes in the pigmented skin? Our patient, grateful that the cause of his trouble had been discovered, volunteered to give us a bit of tissue for microscopical study. Accordingly, a small piece of skin was excised from the lumbar region.

In this specimen the epidermal cells are not hyperpigmented; the corium is the seat of the discoloration. The pigment is distributed almost exclusively about the blood-vessels. Hence, it is seen in the papillæ, but it is most abundant about the basilar layer of capillaries from which the capillary vessels arise. It presents itself in the adventitia of the vascular wall as little brown granules, which lie heaped up to form fine lines, or more frequently very dark ovoid and spindle-shaped groups of about the size of a connective-tissue cell. In many of these collections of pigment nuclei are visible, so that their cellular character is undoubted. The nature of the pigment granule itself is quite obscure. Mr. Fitzrot has kindly made some microchemical tests in the present case, with the same negative results that other observers report. The pigment failed to turn blue when treated with hydrochloric acid and potassium ferrocyanide, and remained unchanged on the addition of ammonium sulphid, or of a five per cent solution of neutral hæmatoxylin. There does not exist the analogy between arsenical pigmentation and argyria that Devergie claimed, for from these experiments it is clear that the pigment contains neither arsenic nor iron. Perhaps, as Geyer suggests, it is hæmatoidin. It is a fact that the long-continued use of arsenic is attended in some individuals by a decided decrease in the hæmoglobin and red blood-corpuscles. The metal itself in chronic poisoning is deposited not only in the liver and spleen, but also in the marrow of the bones; therefore, at the very fountainhead of blood-formation. These observations, added to the microscopical picture, the perivascular deposition, leave little doubt that it is from the disintegration of the blood that the pigment results, but the intimate mechanism of its formation and deposition is entirely unknown.

As to the treatment of arsenical pigmentation, the essential indication is clear. Withdrawal of the drug is usually followed in the course of months by a disappearance of the discoloration. In a few cases the pigmentation has been permanent.

Although melanoderma is a late lesion of arsenical intoxication, keratosis is a still later manifestation, and, in point of time, stands last in the series of arsenical skin eruptions. It is only within the last few years that its arsenical origin has been established beyond dispute. I say beyond dispute in view of the statements made less than two years ago by such eminent dermatologists as Kaposi and Neumann, to the effect that they had never demonstrated with certainty a single case of arsenical keratosis.* After examining this patient and reviewing with me the literature, I will leave you to judge if these statements are warranted by the facts!

Many years ago Romberg wrote of a palmar and plantar

affection in association with the use of arsenic. He stated that he had seen exfoliation of the skin in these regions in individuals who had taken the drug.* But, probably the first definite allusion to an undoubted case of arsenical keratosis is made by Erasmus Wilson, in 1868. In discussing the effect of fifteen months' use of the drug on his patient, he writes: "But the most striking evil resulting from the action of the arsenic next to the melasma is the state of chronic erythema of the palmar and plantar surfaces of the hands and feet. These surfaces are red, hot and swollen; the cuticle is dry, harsh, desquamating and covered with hard, dry points, corresponding with the apertures of the sweat-glands, which resemble minute corns, and which she designates by that name."†

In a report of the terrible epidemic at Hyeres, in France, in 1887, where more than four hundred people were poisoned by wine containing arsenic, mention is made of a case in which the epidermis of the soles, particularly about the heels and balls of the toes, became hard and dry and horny.‡ In the same year, at a meeting of some branches of the British Medical Association, held at Gloucester, Mr. Jonathan Hutchinson called attention to several cases of keratoses of the palms and soles, due, he thought, to the ingestion of arsenic. He thought it probable, too, that the drug might cause a peculiar form of cancer.§

The whole subject received important contributions in 1891 by the publication and discussion of three English observations on palmar and plantar keratoses.|| The third of this series was reported by Pringle as one of "Keratosis of the palms and soles probably of arsenical origin." The patient was a young woman, suffering from psoriasis, who took Fowler's solution for one year. It was then noted that the epidermis of the palms and soles was thickened and keratotic in patches, varying in size from that of a pin's head to that of a pea, so that the skin presented a warty appearance. The affection extended along the lateral borders of the fingers. The description tallies in the main with the case before us. Pringle presented his patient before the Dermatological Society of London, where Mr. Hutchinson gave it as his opinion that the case was one of arsenical keratosis. Considering all of this evidence, there can be at present no doubt as to the existence of such a condition.

The lesion appears after some months or years of arsenical medication, either as a diffuse hypertrophy of the epidermis, or there arise local thickenings of all sizes, giving to the skin a warty appearance. Most frequently, perhaps, the two conditions are combined. Rarely is there any erythema, a circumstance which distinguishes it from the hereditary palmar and plantar keratoses. The palms and soles are usually involved, though, as in this patient, the dorsal and lateral aspects of the fingers and elbows may be affected. As it appears on the

* Klin. Wahrnehmungen u. Beobachtungen, Berlin, 1851, S. 228.

† Jour. of Cut. Med., 1868, Vol. I, p. 355.

‡ Barthelemy: quoted by Rasch, op. cit., p. 153.

§ An address on the study of skin diseases as illustrating the doctrines of general pathology. Brit. Med. Jour., 1887, II, p. 230.

|| Brooke: Brit. Jour. of Dermat., 1891, p. 19. Crocker: *ibid.*, p. 169. Pringle: *ibid.*, p. 390.

* Ann. de Derm. et de Syph., 1898, t. IX, p. 481.

elbows it recalls the condition of psoriasis, hence Mr. Hutchinson's term "arsenical psoriasis."

By what mechanism the lesion is produced is far from clear. Excessive sweating of the palms and soles has been observed during the long-continued administration of arsenic. It may be that, owing to this hyperhidrosis, arsenic is excreted in the sweat in an unusual amount and that the prolonged contact of the drug in these regions may determine the localization of the lesion. The appearance of the "corns" about the apertures of the sweat-glands has been noted in a few instances.

When the arsenic is withdrawn the keratosis usually remains stationary or slowly diminishes. Active treatment with such preparations as salicylic acid should not be undertaken without bearing in mind a third and less fortunate termination of these keratoses, to which Mr. Hutchinson* drew attention at a meeting of the Pathological Society of London, in 1887. Here he elaborated the proposition which he had made at Gloucester that the internal administration of arsenic could be the cause of a "peculiar form of cancer." He presented notes and drawings of three cases in which, following the use of arsenic, not only palmar and plantar keratosis developed but also malignant growths. His thesis drew forth some opposition, but Sir James Paget, who occupied the chair, remarked that he "had seldom heard an argument founded on clinical and pathological evidence more definitely suggesting the conclusion advanced." Mr. Hutchinson's first case was that of a man suffering from psoriasis who had taken arsenic for many years. "Corns" developed on his hands and feet. A corn on the sole of the foot ulcerated, resembling at first a perforating ulcer. According to Sir James Paget's opinion, "the disease was cancerous." Microscopical examination was inconclusive. The growth was removed; the patient recovered.

The second case was one of unusual interest. An American physician had taken arsenic for psoriasis for a long period. The psoriasis was cured, but the skin of the palms and soles became rough. Fungous ulcerations appeared on both hands. Ultimately both hands were amputated. Eighteen months later the patient died. Metastases of epithelioma were found in the left axillary glands, in both lungs, in the suprarenal glands, and in a rib. I shall refer to this case later on.

Finally, the case of a clerk, aged 34 years, who had taken arsenic for a long time for psoriasis, was cited. When he appeared at the Skin Hospital the palms and soles were dotted with "corns." Then an epithelioma of the scrotum appeared. It was excised, but the subsequent movements of the patient could not be followed.

Now, the facts which were thus brought forward were not unknown, but Mr. Hutchinson's interpretation was novel. Thus, in 1874, an epithelioma taken from the foot of an individual suffering from psoriasis is exhibited before the Anatomical Society of Paris.† A few years later, Cartaz‡ reports to the same society the case of a man forty years of

age, suffering from psoriasis, in whom a cancerous ulceration developed over the palmar surface of the right ring finger.

Both patients showed keratoses. They had presumably been treated with arsenic as is practically every case of psoriasis though no mention is made of this fact.

In 1885, Dr. J. C. White,* published an article with the title: "Psoriasis, Verruca, Epithelioma, a sequence." Two cases are reported. The first patient was a man who had had psoriasis of many years' standing. He had taken arsenic in considerable doses. For ten years he had had keratoses on his hands. Three years previous to his examination by Dr. White in 1884 one of these "warts" on the anterior aspect of the right palm ulcerated and a similar but less extensive change took place on the left palm between the fore and middle fingers. The ulcers were viewed as epitheliomata, but before resorting to a radical operation, the patient sought the advice of Mr. Hutchinson and others in Europe. Mr. Hutchinson has pictured the patient's hands in his *Archives of Surgery*.† To his opinion and the subsequent history of the patient I have already alluded in referring to his second case. Let it be added that microscopically the growths proved to be epitheliomata. Dr. White at the same time reported the case of another man, 52 years of age with psoriasis of long standing, warts on the hands and an epitheliomatous ulcer on the anterior aspect of the right wrist and palm. He, too, had been subjected to an arsenical treatment. White considered the psoriasis as a cause of carcinoma through an intermediate lesion, the wart. At that time arsenical keratosis was not recognized. Even now in hearing the reports of these cases of "arsenical cancer," to use Mr. Hutchinson's term, the fact that all the patients were subjects of psoriasis must draw the critic's attention. It may be true that psoriasis with its hyperplasia of the epidermis predisposes to the formation of epithelioma in individuals submitted to continued arsenical medication, but that it is not a necessary condition is illustrated by a case of Ullman,‡ presented to a society of physicians in Vienna in 1898. The patient, a young woman, had been taking Fowler's solution seven or eight years for a facial acne. A palmar and plantar keratosis followed. During the preceding year an epithelioma appeared on the face. It was extirpated. Six months later, another epithelioma which had developed on the thickened skin of the heel, was removed. Here the cutaneous disease, the acne, can have played no rôle, not even that of a predisposing factor, in the development of the new growth. Still more conclusive are the reports of the cases from Reichenstein.§ The three individuals whose histories, Geyer gives had all been saturated with the arsenical drinking water; had acquired the "Reichenstein complexion," and keratosis of the hands and feet. Each suffered from an epithelioma of the right hand.

In a majority of the cases I have now reviewed, the cancer has appeared either on the hands or feet, regions peculiarly susceptible to arsenical keratosis. Indeed, where the details have been carefully observed, it has been noted that the

* Brit. Med. Jour., 1887, II, p. 1280.

† Pozzi, *Bullet. de la Soc. Anat.*, 1874, p. 587.

‡ *Bullet. de la Soc. Anat.*, 1877, p. 549.

* *Am. Jour. of Med. Sc.*, 1885, Vol. LXXXIX, p. 163.

† 1891, Vol. II, plate XX.

‡ *Ann. de Derm. et de Syph.*, 1898, t. IX, p. 481.

§ *Op. cit.*



FIG. 1.—Shows the diffusely thickened skin of the palm, the deepening of the cutaneous furrows and the scattered keratosis.



FIG. 2.—Shows the horny excrescences on the sole of the foot. Their distribution suggests the pressure of the shoe as a determining factor in their localization.

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epithelioma most often arises directly from these keratotic patches.

This fact is not remarkable, knowing how frequently the dermatoses of old age undergo a similar change. Nor is it surprising that the "arsenical warts" of the right hand, constantly exposed to trauma and irritation, most often suffer these changes.

In one of Mr. Hutchinson's cases, the scrotum was the seat of the epithelioma. This localization is of interest in view of the fact that it is an old observation, that the external genitalia are points of predilection of arsenical lesions. Dr. Paris writing in 1825 concerning the poisonous effects of arsenious acid on plants and animals states that "the smelters are occasionally affected with a cancerous disease of the scrotum similar to that which infects the chimney-sweeps."* You see that the very localization of the epitheliomata in these cases favors Mr. Hutchinson's proposition that arsenic "may be the cause of cancer."

To sum up: The present case has given us an opportunity to review a number of interesting and important facts in connection with the administration of arsenic. We have seen that its prolonged use is at times attended with wide-spread pigmentation or keratosis chiefly palmar and plantar, or both pigmentation and keratosis. Associated together, they form a picture which can scarcely be mistaken. The keratosis may in some instances undergo epitheliomatous changes and lead to a fatal termination. The possibility of such a serious outcome, along with other accidents of arsenical intoxication, emphasizes once more that arsenic is no indifferent drug. The occurrence

* Quoted in Butlin's Lectures on Cancer of the Scrotum. Brit. Med. Jour., 1892, Vol. II, p. 67. See also, Brouardel, Troubles de l'appareil cutané dans l'arsenicisme. Gaz. hebdomadaire de Med. et de Chirurgie, 27 juin, 1897, p. 603.

of these dermatoses, however, is not to be viewed as the result of a medical error in its administration. Its use continued for months, and at intervals even for years, is the only relief on which many sufferers from psoriasis can rely.

As with other drugs the range of individual susceptibility is wide. While one will develop a keratosis after a few months of arsenical medication, another may take the drug for years with impunity. Mr. Hutchinson has recorded a life-long use of arsenic for the relief of psoriasis in a man sixty years old.* Speaking generally, it had not interfered with his health.

Strange to say, too, I can find no record of these cutaneous accidents we have been considering among the Styrian arsenic-eaters. That arsenic may be habitually used without deleterious effects, and tolerance to large doses established, is illustrated by Mr. Hutchinson's case and the experience of the Styrian peasants, but such an immunity in medical practice is not the rule. Even Mr. Hutchinson's patient suffered from passing, but nevertheless profound, disturbances which might very well be attributed to the drug. From all of which I conclude that without a definite indication prolonged treatment with arsenic is an error.

A common acne may be combated by simpler and less serious measures than years of arsenical medication! On the other hand, as I have just said, for certain cases of psoriasis and let me add, of lichen ruber, chorea, some grave anæmias, and occasionally for retarding the growth of various malignant tumors, the prolonged use of arsenic is a veritable boon. But in these instances its administration must be under medical supervision and not determined, as in the case of the patient before you, by his fears and opinions. "Virtue itself turns vice, being misapplied."

* Arch. of Surgery, 1892, Vol. IV, p. 104.

UNCONTAMINATED URINE.

BY HOWARD A. KELLY, M. D., *Gynecologist-in-Chief, The Johns Hopkins Hospital.*

THE BEST WAY TO SECURE UNCONTAMINATED URINE FROM THE BLADDER AND FROM THE KIDNEY, AND HOW TO MINIMIZE THE RISKS OF CATHETERIZATION IN WOMEN.

The question of catheterization is ever a burning one, whether in the large clinic after important pelvic operations, where it is conducted on a wholesale scale, or in the case of the single patient at her home after confinement. In view of the frequent immediate untoward results of catheterization and their distressing sequelæ, I think we might almost reckon this procedure among the major gynecological operations, until the question as to the safest method is finally solved.

The first query of importance is, "Who shall catheterize the patient—shall the doctor or the nurse?" A little consideration will show that it would be practically impossible for the doctor, when at a distance and otherwise engaged, to add this to his already burdensome duties, and it must therefore be looked upon as distinctively a nurse's duty. (See Fig. 1.)

To this end the nurse must be especially trained; she must

be warned of the unusual risks and taught each step with great exactitude. The method I have adopted for some years past in my own clinics is the following:

I prefer to use a glass catheter, which I first tried in 1884, when I made one extemporaneously for an urgent case out of the glass tube of a baby's feeding-bottle; the glass is easily kept clean, and can be introduced *without touching the end which enters the bladder*. (See *Amer. Jour. Obs.*, February, 1889, p. 184.) (See *Kuestner Centralb. f. Gyn.*, 1890, No. 23.) (See also an excellent article by Prof. Kuestner, on glass catheters, as a means of prophylaxis against cystitis in women, *Deutsche med. Woch.*, 16 May, 1883.)

Each patient has her own catheter for her exclusive use as long as she needs one. It is sterilized by boiling five minutes in a soda solution and then placed in an open-mouth bottle

filled with 5 per cent carbolic solution, or 1-1000 bichloride of mercury with some cotton on the bottom to protect the end of the catheter.

Just before using it may be boiled again in the soda solution.

The nurse then scrubs her hands carefully and places the patient on a bed-pan and exposes the vulva and separates the labia so as to expose the urethral orifice.

She now takes up a pledget of cotton, saturated with a boric-acid solution, in the grasp of a forceps, and with this thoroughly cleanses the urethral orifice. This is repeated with another pledget when the patient is ready for catheterization. (See Fig. 2.)

She now draws two sterile finger-cots over her thumb and index finger of the right hand, and thus well protected grasps the catheter by its outer end and removes it from the receptacle, rinses it off with sterile water, or if it has just been boiled lifts it directly from the pan, and gently introduces it into the urethra, allowing it to take its own way into the bladder and never under any circumstances using force.

I desire here to point out the fact that the catheter never completely empties the bladder when the patient is lying down; and if there is any cystitis it is best to wash it out, using a large catheter with a strong curve at its vesical end. After the irrigation the curved end is turned downwards towards the base of the bladder, when the sediment often escapes first.

Uncontaminated urine may be obtained from the bladder for bacteriological study in the following manner:

The catheter is sterilized with a piece of rubber tubing covering an inch or more of its outer end and projecting about 2 inches beyond it. It is then introduced, preferably

by the physician, with the precautions described, and the urine allowed to escape for a few seconds, after which the rubber sleeve is pulled off and the urine now running over the sterilized end of the catheter is collected in a test-tube. In my investigations of several hundred specimens in this way conducted with my associate, Dr. Thos. R. Brown, we have had no cases of accidental contamination. *In twenty instances sterile urine was taken as a control experiment and in every case it remained sterile.* (Fig. 3.)

In securing uncontaminated urine from the kidney, I proceed in a similar manner. The bladder is washed out and emptied, and the patient is put in the knee-breast posture and the ureteral orifice exposed. This may now be cleansed with a little pledget of boric-acid solution and the catheter introduced.

The catheter is sterilized with a rubber sleeve protecting and projecting beyond the end. The operator draws on the hand which grasps the catheter a sterilized half-glove, which I have had made for this purpose, and grasping the catheter, protected also if need be by a sterile towel on his shoulder, he introduces the end into the ureter and pushes it on up into the kidney. The patient is then allowed to lie down on her side or on her back, the sleeve is pulled off, and the sterile end of the catheter is put in a sterile test-tube held in place by the cotton plug.

I have done this not less than sixty times and have never yet seen an accidental contamination.

It is evident, therefore, that by this procedure, when the ureter is catheterized by my method through the open speculum in an air-distended bladder, we possess a method of securing cultures from infected kidneys which is impossible in any other way short of a surgical operation.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

ARTHUR W. ELTING, M. D. The Bacteriology of Gonococcus Infections.—*Albany Medical Annals*, March, 1900.

HARVEY CUSHING, M. D. Exploratory Laparotomy Under Local Anesthesia for Acute Abdominal Symptoms Occurring in the Course of Typhoid Fever.—*Philadelphia Medical Journal*, March 3, 1900.

NORMAN B. GWYN, M. D. The Examination of the Urine for Typhoid Bacilli.—*Philadelphia Medical Journal*, March 3, 1900.

ROBERT REULING, M. D. Changes in the Skin in Paralysis Agitans.—*Maryland Medical Journal*, March, 1900.

ROBERT REULING, M. D. Pathology and Neurology.—*Maryland Medical Journal*, March, 1900.

GEORGE WALKER, M. D. Electrolysis as a Means of Curing Chronic Glandular Urethritis.—*Maryland Medical Journal*, March, 1900.

THOMAS R. BROWN, M. D. Internal Medicine.—*Maryland Medical Journal*, March, 1900.

HUGH H. YOUNG, M. D. Surgery.—*Maryland Medical Journal*, March, 1900.

GEO. W. DOBBIN, M. D. Obstetrics and Gynecology.—*Maryland Medical Journal*, March, 1900.

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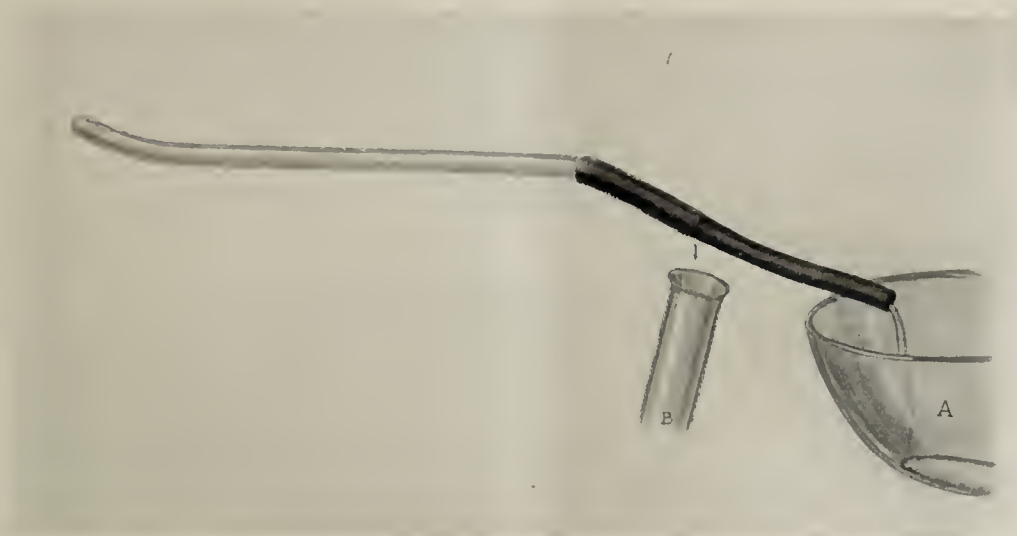


FIG. 1.—The sterilized glass catheter, protected by a rubber sleeve. When first introduced, a little urine is allowed to escape into the vessel A; then the rubber sleeve is pulled off, and uncontaminated urine runs directly from the end of the glass tube into the sterile tube B.

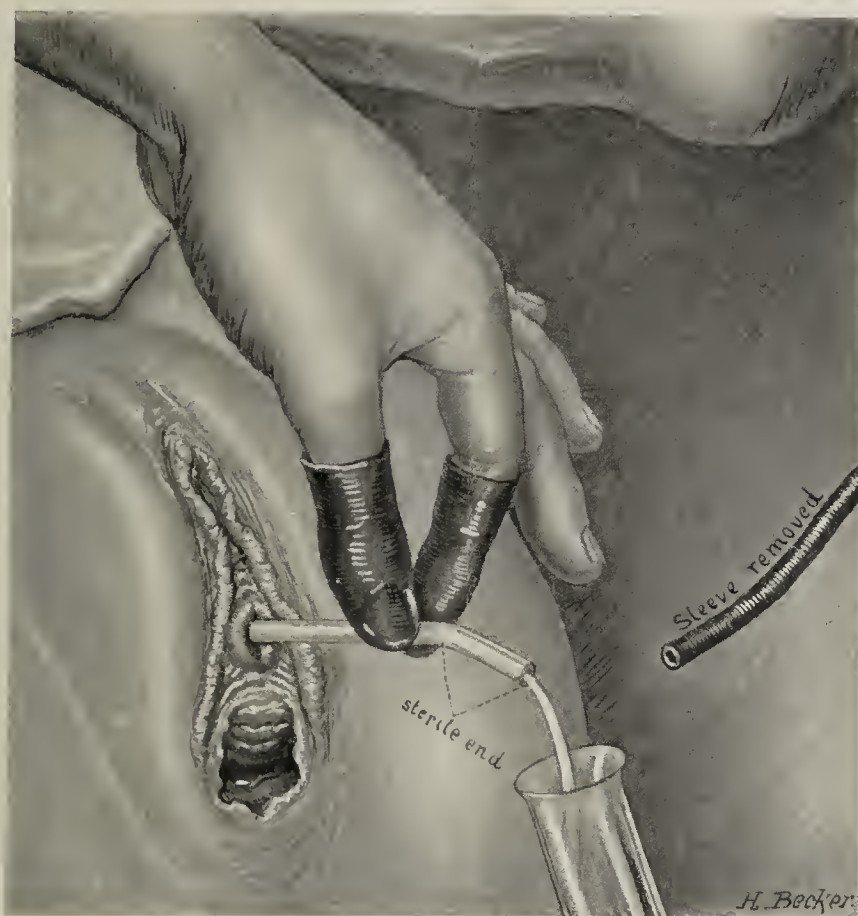


FIG. 2.—Shows the nurse holding the catheter with fingers protected by sterile rubber finger cots, while the urine escapes from the sterile end into the glass tube upon removal of the rubber protecting sleeve.

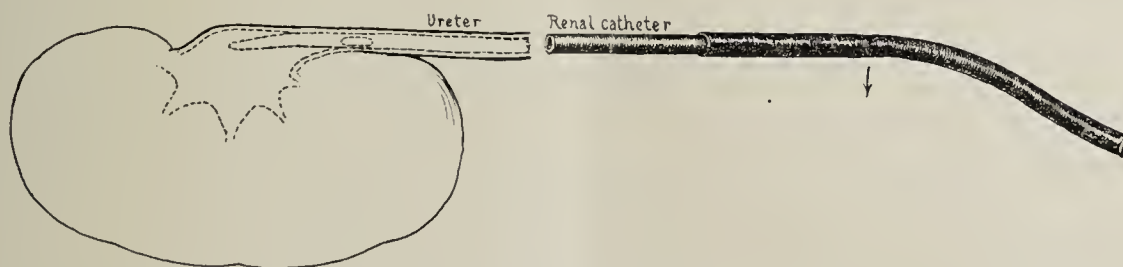
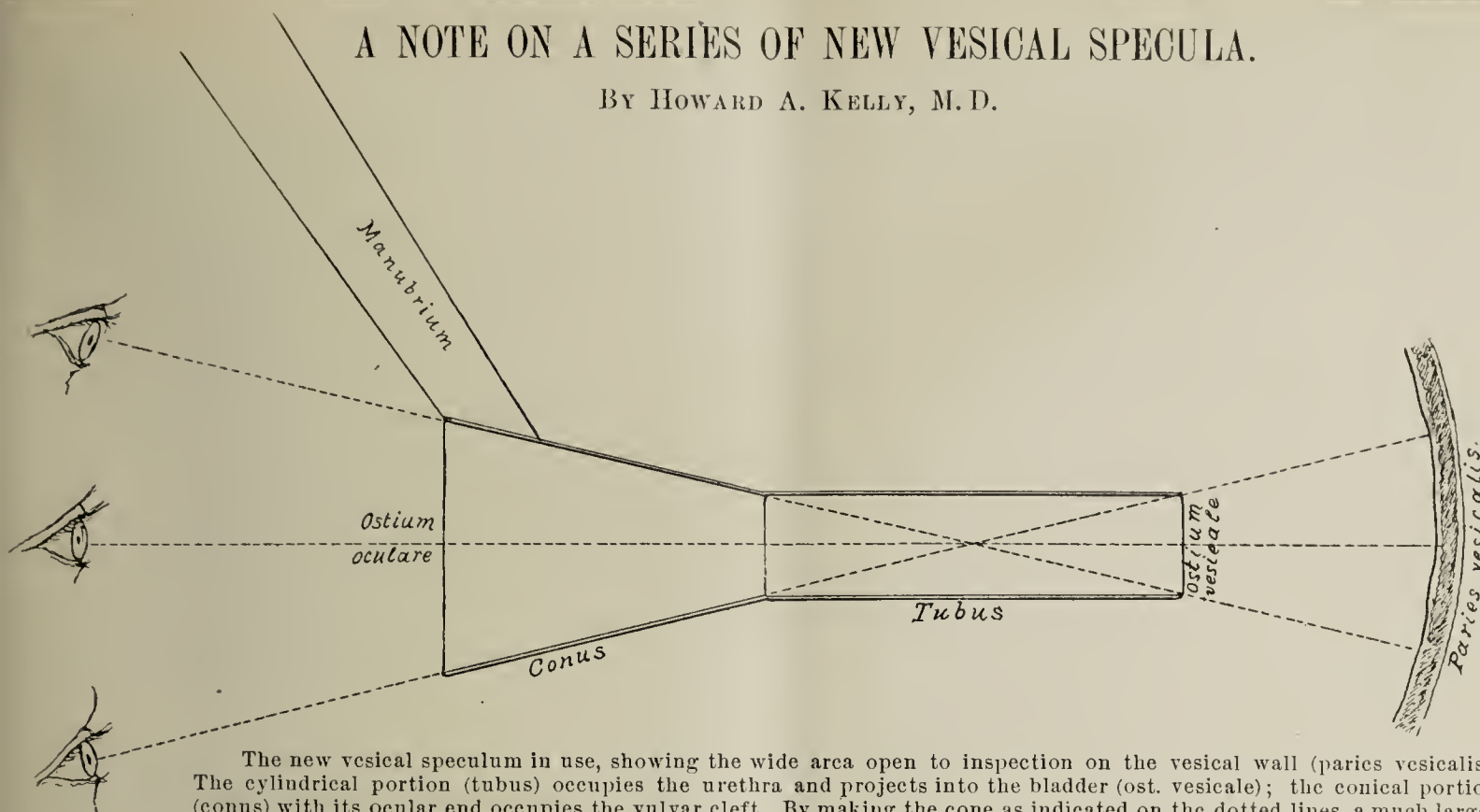


FIG. 3.—The renal catheter protected by the rubber sleeve. On introduction, the sleeve is pulled off and the end of the catheter, marked by the arrow, inserted in a sterile tube and uncontaminated urine collected.

T. J. WRY
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A NOTE ON A SERIES OF NEW VESICAL SPECULA.

By HOWARD A. KELLY, M. D.



The new vesical speculum in use, showing the wide area open to inspection on the vesical wall (*paries vesicalis*). The cylindrical portion (*tubus*) occupies the urethra and projects into the bladder (*ost. vesicale*); the conical portion (*conus*) with its ocular end occupies the vulvar cleft. By making the cone as indicated on the dotted lines, a much larger field is secured for inspection and for instrumentation. The tube in some cases may with advantage be made 2 cm. longer, when it projects further into the bladder and serves to push up the base of the bladder in inspecting it.

The open cylindrical vesical speculum when in use is topographically divided into a urethral and a vulvar portion. The calibre of the urethral portion is limited by the degree of safe or convenient distention of the urethra, and in the range of specula ranges from No. 9 to No. 12 (the numbers in the scale representing millimetres in diameter); in the larger specula, used for operations, the calibre may even be carried as high as 20 mm., the limit of a safe degree of dilatation, as shown by Simon.

The vulvar portion, however, has no such necessary limitations and may, as I have found, be expanded with great advantage into a broad funnel. The best form of funnel is one in which the angles formed by the lines of the slanting sides meet exactly in the middle of the tubular portion. This gives a maximum area of inspection and a maximum room for treatment, especially in using instruments with crossed blades. The length of each of these parts of the speculum should be 5 cm.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, February 19, 1900.

Pathological Findings in a Case of General Cutaneous and Sensory Anaesthesia.—DR. BERKLEY. (See BULLETIN for March.)

SPECIMENS OF FALSE PORENCEPHALIA. DR. BERKLEY. The person from whom this specimen was obtained was a medium-grade imbecile, who had lived to reach the age of 58 years. He was tall, with fairly developed musculature, and without marked cranial deformity. At the autopsy, the brain weighed 950 grammes. The convolutions on the external aspect of the hemispheres were without any marked asymmetry, but the right half of the brain was considerably smaller than the left, and when taken out of the bony envelope, flattened perceptibly. On closer examination, a defect was found on the median-inferior aspect of the hemisphere, measuring 10 centimetres in its greatest length by two in its greatest

width. The anterior margin lay considerably forward of the splenium of the corpus callosum, the posterior end stopped three and a half cm. before the tip of the occipital lobe. The defect was separated from the ventricle by a leathery substance, from 1.50 to 1.75 mm. in thickness. This showed no trace of cerebral matter. The lesion formed a pocket beneath the general level of the surrounding brain-tissue, which was filled with a gelatinous mass. The convolutions involved were portions of the posterior end of the convolution of the corpus callosum, the anterior and middle parts of the lingual convolution, the innermost aspect of the occipito-temporal gyrus, and a large part of the convolution of the hippocampus. The cuneus was not disturbed. The foot of the hippocampus was not entirely destroyed, its anterior portion retaining some of the nerve elements. In the posterior portion of the hippocampus the traces of an old hemorrhage were found, showing that the lesion had originated in the rupture of a blood-vessel. The corpus callosum throughout its whole extent was poorly developed, but the posterior half was especially thin, an evi-

dence that the injury to the cortex had taken place in early life, and that the hemispheres had not fully developed thereafter. When the right and left sides of the corpus callosum were compared in the cross-sections, the left side was seen to be thinner than the right. There were no indications of localized brain lesion during life.

On a Form of Conjugation of the Malarial Parasite.—DR. EWING.

In four cases of tertian infection the writer has encountered appearances in the blood which seem to admit of no other explanation than that of conjugation of malarial parasites. In a considerable number of other cases similar appearances were found, but much less frequently.

The blood in these cases showed a large number of young rings and many half-grown and full-grown forms. A great many cells showed double infection with young rings. In many instances these rings were entirely separate, each exhibiting a single large granule of chromatin. Many cells, however, contained two rings, which were clearly fused together along one segment of the ring, and two large chromatin granules were then invariably found at different points in the rings. The fused parasites usually differed in appearance. One was a large delicate ring with a thin bow, and chromatin granule of moderate size, while the other was a coarser body with thickened bow, enclosing little or no hæmoglobin, and exhibiting a large chromatin granule.

Among the single rings, these two forms of young parasites were often distinguished, but no single rings could be found containing two equally large chromatin granules, while every red cell that exhibited two large and equal chromatin granules contained also two distinct rings. It appears, therefore, that the bodies of many parasites had become fused together, while their nuclei remained separate.

On examining the parasites in later stages of development, most of them were found to have lost the ring form and to have spread out into a large number of threads, with nodal thickenings variously curled in the red cell. These threads evidently represented the pseudopodia of a very active amœboid stage. The chromatin masses were now subdivided into ten or twelve granules; but, in the majority of the cases, these masses were far apart and showed no tendency to unite. In many cells, however, the amœboid figures were less marked, and the masses of chromatin lay side by side, united by a little achromatic substance. Later some parasites were found in which the two groups of rather large chromatin granules lay in immediate apposition, surrounded by achromatic substance. This phase was marked by a distinct reduction in the length of amœboid figures.

Many older spheroidal, hyaline forms, belonging to this same brood, were found in these cases, but all the older hyaline forms were single, and exhibited a single large group of fine chromatin granules. Not one cell harboring two full-grown parasites could be found in prolonged and repeated searches through several slides. Whatever interpretation may be placed upon this peculiar absence of older twinned forms, the finding of all stages of union, first of the bodies and later

of the nuclei, likewise appears to admit of no other explanation than that of conjugation.

DR. WELCH.—I have been greatly interested in Dr. Ewing's paper, and consider that the Society is to be congratulated upon this opportunity to listen to his personal presentation of these important observations. There can be no question as to the accuracy of these observations, whatever difference of opinion there may be in their interpretation. Most of the questions which had occurred to me in the course of Dr. Ewing's remarks, he answered before their conclusion.

The most important question seems to me whether the conjugation of parasites described by Dr. Ewing, is to be looked upon as something essential, really pertaining to the life history of the organism, or as merely a more or less accidental coalescence, or fusion, of two cells. Of such fusion of cells we have some examples in normal and pathological processes, and if this latter be the proper interpretation, there may be some question as to the propriety of the designation "conjugation," which has a special meaning among biologists. I do not know that Dr. Ewing is in a position to express himself more definitely upon this point.

DR. THAYER.—We all, I am sure, feel grateful to Dr. Ewing for the very interesting communication which he has made. I regret extremely that Dr. Lazear is not here to take part in the discussion, inasmuch as he has for the past year been making careful studies in this line. Unfortunately, he has gone to Cuba, and his specimens and the paper which I had expected to have in time to read to-night have not been received.

Dr. Ewing's interpretation of his interesting observations is extremely suggestive. I recognize many of the pictures which have been described, but I must confess that their possible importance had escaped me. I have, without much thought, always assumed that the reason why twin parasites were relatively common in the early stages of development of the organism and so infrequent later on was that with the growth of the several contained organisms the red blood-corpuscle was eventually ruptured, both parasites escaping and meeting the fate which apparently inevitably befalls extra-cellular bodies at this stage of development. But, after all this is a pure hypothesis, and in view of Dr. Ewing's careful studies I should surely feel called upon to thoroughly restudy the question before venturing to dispute his conclusions.

A rather interesting point in connection with this matter if we are to regard the process as one of fusion, is that at a certain stage the structure of the organism might justify the term *plasmodium*, the biological inaccuracy of which as applied to the ordinary parasites has been so generally recognized.

In connection with the possibility that this process might be a true conjugation, a rather inviting, though I fear improbable, explanation of its possible significance suggested itself to my mind.

In the æstivo-autumnal parasite, for instance, beside the organisms pursuing the ordinary cycle of development, there soon appear other bodies morphologically distinct from these the crescentic and ovoid forms. These forms, Mannaberg

tends, are the result of conjugation of two elements belonging to the ordinary cycle.

Only from the bodies belonging to the crescentic group do the sex-ripe forms (macrogametes and microgametocytes) develop.

In a recent communication Bastianelli and Bignami assert that the sex-ripe forms in the tertian parasite likewise develop from elements morphologically distinguishable from those belonging to the ordinary cycle.

What causes the differentiation of the crescent group in the vivo-autumnal parasite and of the group destined to develop into sex-ripe forms in the tertian parasite? May it be that these sex-ripe forms in both instances develop only as a result of conjugation of two bodies, each of which alone would be capable of pursuing only the ordinary asexual cycle—that the process observed by Dr. Ewing is a necessary stage in the production of elements destined to develop into flagellate forms (microgametocytes) or macrogametes?

I am, however, unaware whether there is any analogy to justify such an hypothesis—and what is more important the fact that the crescents are formed as a result of conjugation by no means settled. Indeed, we are inclined to believe, like the Italians, that this is not the case.

DR. MACCALLUM.—I would like to ask one or two questions of Dr. Ewing. 1st, Whether he has seen any actual fusion of chromatin bodies, or whether they simply lie side by side as he has pictured them; and, 2d, What happens after this—whether there is any difference between the conjugated forms and the others. As I understood him, they both go on to sporulation; and it struck me as an occurrence which has its parallel in certain lower animals, that conjugation should take place in these young immature cells. I would also like to know whether he has observed this only in one cycle or in several successive cycles.

DR. EWING.—When I made up my mind to read this paper in Baltimore, it was with the idea that I could obtain more information here than anywhere else on a point which concerns the minute morphology of the malarial parasite. This decision seems to have been justified, and I feel that I am now in a better position to consider the importance of this process.

Dr. Welch has hit the nail on the head in regard to the significance of the process. I am fully convinced that all the stages I have described actually occur, but it is a totally different thing to ascribe to such a process its proper interpretation. I am inclined to think that this process has not the significance we find it to have in certain lower animals where conjugation is a *necessary* preliminary to sporulation. It is certainly not so of the malarial organism. I only claim that it occurs frequently, and is a real fusion of parasites, undergone for convenience, perhaps, but is not an essential preliminary to sporulation. I thank Dr. Welch very much for making the suggestion that clearly places the process in its correct position.

I confess that I had not had in mind the possibility that when two parasites conjugate the result might be the rupture of the cell and death of both parasites. I had suspected that one might claim that one parasite, gaining the upper-

hand, had destroyed the other, but it had not entered my mind that both might be thrown out.

Now, what can be said as to the possibility of such a process occurring? It seems to me that if it does occur with any frequency, it would occasionally be observed in some specimen; and it seems, on general principles, extremely unlikely that if such a rupture and extrusion occurs, we should examine hundreds of specimens and fail to find any trace of such a process. I have been over these slides until my eyes hurt, and have not found any traces of the rupture of cells and extrusion of twin parasites. The suggestion is an extremely good one, however, and I shall hereafter bear it in mind. I am somewhat surprised that I did not think of it before, and I want to thank Dr. Thayer for the suggestion.

In regard to Dr. Thayer's suggestion concerning the relation of this process of conjugation to the life history of the parasite and preparing it for growth in the mosquito, I have not allowed myself to draw any conclusions whatever on that point. I am inclined to think, with Dr. Welch, that it is a mere fusion taking place when they are very numerous, and has probably nothing to do with the development of flagellate bodies or of any form especially adapted to growth in their new host. It seems rather to increase the numbers of young parasites produced in the human host. I was unable to trace the full development of some of the single parasites. This, also, is an extremely important point, and is the one I had foremost in mind in discussing the subject. I have noticed in these conjugating specimens that I can hardly ever get any flagellate bodies.

Dr. MacCallum wishes to know if I have actually seen fusion of the nuclei. I have not. I do not see how it is possible in the fresh specimen to accurately follow the process of union of masses of chromatin, such as we are dealing with here. My experience is that only the grosser processes can be identified with certainty by such means, and I feel that the identification of the nuclear bodies in the fresh specimen, as concerned in this process, would be unreliable in my hands. I should prefer to leave that to some one more familiar with the study of fresh-blood specimens. I do believe very firmly, however, that such union of nuclei does occur, from study of stained specimens. The same answer applies to his last question: Have I followed the development through several generations or only in one? I have not been able to follow up more than one generation, because we are in New York seldom able to follow these cases long. In the cases of the soldiers at Montauk, I had to take many specimens within a few minutes and usually saw the patient but once.

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BULLETIN

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URINARY ANOMALIES.

- I. SIMULATIVE NEPHRITIS.
- II. POST-OPERATIVE GLYCOSURIA.
- III. MALINGERING MELITURIA.

By THOMAS R. BROWN, M. D.

I. SIMULATIVE NEPHRITIS (after Nephrotomies and Nephropexies).

The exact etiology of nephritis is still such an unsolved problem that anything that has the least bearing on even the smallest part of this problem should, we think, prove of some interest.

Besides the fact that a nephritis may be brought about by exposure to cold or by the action of various poisons—as those of the specific fevers, various chemical substances, and the lesions produced by skin-burns—very little is known of the true nature of the condition.

I wish in this brief communication to report an interesting case of urinary anomaly, which I have designated by the name of “simulative nephritis,” occurring after certain simulative operations upon the kidney.

These operations of nephropexy, or stitching the kidney in place, have become quite common within recent years, due to the work of Glénard and his school, and the demonstration of the characteristic and distressing symptom-complex noted in those suffering with a falling, or ptosis, of the kidneys, or “nephroptosis;” while we may also have a falling of many of the abdominal organs, usually associated with symptoms of a similar nature to those seen in cases of nephro-

ptosis, Glénard designating these conditions as “gastroptosis,” “hepatoptosis,” “splenoptosis,” according to whether the stomach, liver, or spleen is displaced, while a general displacement of all the abdominal viscera is known as “enteroptosis.”

My attention was first called to the urinary peculiarities, after operation for floating kidney, by a case (Case I)—seen for the first time last year—in which the patient complained of severe pain in the left renal region, and, as nothing seemed to relieve it, an exploratory nephrotomy was decided upon.

The urine had been examined on four occasions previous to the operation, and was found to be perfectly normal, except for a number of red blood-cells and the amount of albumin one would expect with such a degree of hematuria, brought about by catheterization of the ureter, on the last two examinations. The operation consisted of an exploration of the kidney, an artery forceps being forced through the renal tissue into the renal pelvis to determine whether or not a stone was present; and, after the negative results of this examination, the closure of the renal wound and the stitching of the kidney to the posterior abdominal wall.

On the day following the operation the urine, of specific gravity 1.022, besides containing many red and some white

blood-cells and epithelial cells, contained enormous numbers of casts of all kinds—hyaline, finely and coarsely granular, blood and some epithelial—the microscopic field being simply crowded with them. The urine contained a considerable amount of albumin, but no sugar.

In six days the urine, of specific gravity 1.026, had cleared up considerably and contained but a trace of albumin and few blood and epithelial cells, but there were still a number of hyaline casts, and a few granular, blood and epithelial casts; while ten days later the urine, now of specific gravity 1.017 and showing but a faint trace of albumin, still showed a few hyaline casts and now and then a granular or epithelial cast, with a few red and white blood-cells and epithelial cells.

A bacteriological examination of the urine made at the height of the condition showed that it contained no micro-organisms. The urine was obtained under the most careful aseptic conditions and cultures made upon the various media, but the results were all negative.

The patient leaving at this time, the urine was not again examined for several weeks, when it was found to contain neither albumin, blood-cells, nor casts; and again, ten months after the operation, the urine was found to be absolutely normal.

Associated with this urinary condition there had been absolutely none of the symptoms of a nephritis, no edema of the legs, no ascites, no retinal symptoms, no more headache and nausea than would be expected after ether anesthesia; while the quantity of urine voided was about the same as is usually seen after the administration of ether by inhalation.

The most striking characteristic of the urine was the marked disproportion between the number of casts and the amount of albumin present, the latter being so much less than one would expect from the great number of the former.

Since this case, which was regarded as being of peculiar interest, I have followed, as carefully as the circumstances would allow, all the cases of nephropexy that came within my reach.

In all, four such cases have been followed carefully, while in two other cases the urine was examined at a quite considerable time afterwards; but, as we shall see shortly, the results of this late examination are of slight interest, as the study of the other four cases has demonstrated that an early examination is absolutely essential.

In two of these four cases, in which the urine was examined immediately after operation, it was found to be normal except for a trace of albumin and a few blood-cells as one would naturally expect after the operation performed; no casts were seen after a most thorough search.

In the other two of the four cases carefully studied, however, the conditions found were, I think, of sufficient interest to warrant their being described at greater length. In the first of these the urine on the day before the operation was acid, of specific gravity 1.018, containing neither sugar nor albumin, while a microscopic examination showed only a few uric acid crystals and threads of mucus. On the day following the operation—a simple nephropexy—the urine contained a small amount of albumin, but an enormous number of casts, mostly hyaline, some granular, and an occasional

blood-cast, with some red and a few white blood-cells and epithelial cells.

On the next day, there was but a trace of albumin, a few red blood-cells and very occasional white blood-cells and epithelial cells, but still hyaline casts in moderate amount while two days later both albumin and casts had entirely disappeared.

The patient was in a rather poor general condition, and the blood contained but sixty-one per cent of hemoglobin.

The second case was very similar, showing on the day preceding the day of operation a normal urine of specific gravity 1.020 with no sugar, no albumin, and a few epithelial and pus cells (voided specimen), while on the evening of the day of operation, the urine of specific gravity 1.016, while showing but a trace of albumin, showed enormous numbers of casts, hyaline, finely and coarsely granular, and blood-casts with few free red blood-cells and epithelial cells.

On the following two days the urine contained but a trace of albumin, the specific gravity was 1.020 and 1.028 respectively, while on the first of these two days the sediments still showed enormous numbers of casts though not in quite so great abundance as the night before (mostly hyaline and granular with a few blood and epithelial casts), with a few red blood-cells and epithelial cells and occasional white blood-cells, while on the second day the only casts present were the hyaline and finely granular, which were still quite numerous with an occasional red blood-cell, white blood-cell and epithelial cell.

Five days later the albumin and casts had entirely disappeared, and the only things seen in the sediment were occasional red and white blood-cells.

In the other two cases, the urine was not examined until the fourth and seventh day respectively after the operation, and neither casts nor albumin were found in either, but only an occasional red and white blood-cell.

These latter cases, however, as mentioned before, are of little interest because of the lateness of the urinary examination. Thus, of five cases in which the kidney was stitched in place, in three we have found in the urine what would lead one on microscopic examination to make a diagnosis of acute nephritis, and yet associated generally with but a trace of albumin, and having none of the clinical signs and symptoms of such a disease.

In all the cases the urine was perfectly normal before the operation and after this transitory cylindruria. We have evidently, four factors distinctly involved in the production of this condition: 1st, the handling of the kidney, usually quite slight, except in the first case, in which a nephrotomy was also performed, and where the cylindruria and albuminuria persisted for a much longer period of time; 2nd, the taking of the stitches through the renal substance, and, in the first case, the trauma necessary in an exploration of the renal pelvis; 3rd, the irritation of the renal tissue by the ether, that is, in part, eliminated by means of the kidneys—a well recognized condition as shown by the fact that a definite nephritis occasionally develops after protracted operation under ether anesthesia, this point having been gone into in detail very recently by Galleazzi and Grilo (Gior. d. R. Acad.

ia di Torino, 1899, p. 293); 4th, the diminution in the elimination of fluids which is almost invariably seen after ether anesthesia, and which undoubtedly subjects the kidney to a greater chance of becoming diseased.

Probably in the development of this "simulative nephritis," these factors play a part, although the stitching and handling are probably of most importance as evidenced by the fact that the urinary condition was so much more marked and persistent in the case where the trauma and handling were greatest, viz: the first case, where both a nephrotomy and nephropexy were performed.

In connection with the effect of trauma upon the kidneys a recent article of Professor Stern, of Breslau (*Monatschrift für Unfallheilkunde*, 11, 1899), is of interest.

He considers in this article the definite relation between trauma and the development of nephritis, and after mentioning the extreme rarity with which nephritis develops after injuries, blows, falls, or contusions in the kidney region, describes the following conditions which may arise after such injuries:—1st, cases which either rapidly end fatally or are rapidly cured, in which the urinary picture is that of an acute nephritis, but with *more* albumin than one would expect from the number of red blood-cells; in the cases that came to autopsy an extensive renal necrosis was to be made out, but no nephritis; 2nd, cases of long-lasting albuminuria with casts in the urine, without the general symptoms of a diffuse nephritis; the condition may last for more than a year but is extremely rare, and, so far, no autopsy records are to be had in such cases; probably these are cases of circumscribed inflammatory processes following the renal trauma; 3rd, typical cases of diffuse nephritis after trauma; in the literature a number of such cases are to be met with, with the characteristic urinary picture, and also the œdema, retinal changes, toxic manifestations, etc; certainly in some of these cases, at least, a latent chronic nephritis was probably present before the injury.

While the number of our cases is small, it is probable that we also may have analogues to the post-traumatic phenomena described by Stern, the extent of the condition probably depending upon the amount of trauma and handling which the kidney sustained during the operation, the amount of ether used, the general condition of the patient and the local condition of the kidney before operation.

Thus, in some cases we will only have the presence of a few red blood-cells and a trace of albumin rapidly clearing up; in others a urinary picture resembling a nephritis but *less* albumin than would be expected from the number of casts and red cells present (differing in this respect from Stern's observations after trauma) and no other symptoms, the condition clearing up in a few days; in others a cylindruria and albuminuria of higher grade and longer duration, often lasting several weeks, but unaccompanied by other symptoms and finally clearing up entirely (examples of these cases are to be found in our five cases); while a longer persisting cylindruria with some albuminuria, and even a typical diffuse nephritis, must be considered as possibilities.

II. POST-OPERATIVE GLYCOSURIA.

Since the original experiments by Claude Bernard, the subject of the disorder of metabolism, known as glycosuria, has been one of surpassing interest.

Certain experiments and discoveries have thrown some light upon the etiology of this condition, notably Bernard's celebrated *piqûre diabétique*, by which he showed that by puncture of a certain spot in the floor of the fourth ventricle polyuria and glycosuria could be produced; Lancereaux's, von Mering's and Minkowski's demonstration of the relationship which existed between certain pathological conditions of the pancreas and glycosuria; and the more recent work on alimentary glycosuria in various conditions, notably diseases of the liver, kidney and cerebrospinal apparatus, in which the organism is unable to appropriate the amount of sugar usually given (100 grammes) and some therefore passes into the blood, raising its sugar-content, and causing hyperglycemia and glycosuria.

It would be obviously unprofitable in an article of this kind to do more than touch upon some of the conditions in which glycosuria has been noted.

According to Abeles, Wedenski, Schilders, Moritz, Baisch and Kleen, there is a faint trace of glucose in normal urine, while Brunton has recently shown that after breakfast, the meal richest in carbohydrates, traces of sugar can usually be demonstrated in the urine.

Besides diabetes mellitus, the alimentary glycosuria and the physiological glycosuria just described, glucose has been found in the urine in a variety of diverse conditions, the condition usually being of low grade and transitory. Many cases of this nature have been reported, and to describe all the conditions in which glycosuria has been found would take me beyond the limits of this paper; it is of interest, however, to note some of the more important of these transitory glycosurias.

For convenience these cases may be divided into three groups: (1) the toxic; (2) those associated with diseases and injuries of various kinds, although probably in many cases of the latter group, a toxemia of some kind plays a considerable rôle in the etiology of the condition; and (3) puerperal glycosurias.

(1). *Toxic*.—Transitory glycosuria has been described after the use of amyl nitrite, mercury, hydrocyanic acid, sulphuric acid, alcohol, strychnia, glycerin, nitro-benzol, thyroid extract, lead, phloriazin, caffeine, diuretin, phosphorus, arsenic, carbon monoxid, morphia, tuberculin, pancreatin, while of the analgesics and anesthetics, a transitory glycosuria has been described after chloroform, chloral, amyl nitrite—in the case of the last-mentioned drug the sugar sometimes reaching two per cent—while Harley, Kleen and Von Jaksch describe the appearance of small quantities of sugar in the urine after ether, and Andral describes a case of true diabetes developing after ether anesthesia.

Of course, in some of these the only tests used were Fehling's or Trommer's tests, and recent work has shown that occasionally we find other reducing substances in the urine, especially glycuronic acid.

Thus, undoubtedly, in some of the cases described above the reducing substance was not glucose but glycuronic acid, as Marchot has shown with chloralamid; Ewald, von Mering and Magnus-Levy, with nitrobenzol and nitrotoluol; and Hoppe-Seyler with orthonitrophenylpropionic acid; thus, before we definitely prove the presence of glucose in the urine, besides Fehling's or Trommer's tests, the fermentation test, the polariscopic test, and the phenyl-hydrazin test should also have been made.

(2). *Associated with diseases or injuries.*—Transitory glycosuria has been described as occurring during the course of cerebrospinal meningitis, cholera, typhoid fever, relapsing fever, diphtheria, tetanus, phthisis, many of the exanthematous fevers, hepatic fibrosis and rickets. Frerichs has described it in gastritis; Da Costa in old age; Burdel during the malarial paroxysm; Rotch in scarlatinal nephritis; Ord in angina pectoris and chronic interstitial nephritis; Exner in cholelithiasis, though Rausch vigorously denies this; Marchot in syphilis; while after pertussis, asthma and a variety of other diseases, a faint trace has been occasionally found.

Of especial interest are those cases of transitory glycosuria found after injuries to the cerebrospinal apparatus and in various mental and nervous diseases. Thus, it has been described in cerebral, bulbar and pontine hemorrhage; after concussion of the brain or spinal cord; in cerebral tumor, abscess, softening and parasitic disease; in disseminated sclerosis; in epilepsy and epileptic insanity; in neuralgias of various kinds, especially sciatica; in exophthalmic goitre; in "a fatal case of myxedematous condition with tachycardia, melena and mania" (by Osler); in Friedreich's disease (by Best); in sexual neurasthenia (by Peyer); while it has been frequently seen in some of the functional neuroses, as Charcot's grand hysteria, the traumatic neuroses, neurasthenia, severe psychical derangements, and after great emotion.

Kleen has given the name "functional nervous glycosuria" to those cases where sugar appears in the urine in cases of acute or chronic "functional" nervous disturbances, and mentions several interesting cases where a transitory glycosuria was noted after grief, anger, excitement and other emotions of various kinds.

(3). *Puerperal glycosurias.*—Recent work has shown that a puerperal lactosuria is much more common than a puerperal glycosuria, although the latter is found in a certain number of cases.

Roque (Les glycosuries non diabétiques, Paris, 1899) makes the following divisions of the subject:

A. *Intermittent glycosurias of arthritics*, while as subheadings, are put the hereditary form in the young, the gouty form in the adult and old man, that of the obese, and the azoturic.

B. *Digestive glycosurias*, subdivided into that form seen after eating excessively of sugars, or carbohydrates; and that form seen in digestive disturbances.

C. *Nervous glycosurias* made up of those seen in the systemic affections of the nervous system, those seen in the neuroses and psychoses, and the traumatic glycosurias.

D. *Puerperal glycosurias.*

Hofbauer makes a somewhat different division of the trans-

itory glycosurias, dividing them into the *neurogenic*, *febrile*, *toxicogenic* and *puerperal*.

The cases I wish to report, three in number, are examples of transitory glycosuria after ether anesthesia. The first case was in a white woman of fifty-nine, who was successfully operated upon for carcinoma of the uterus, and hemorrhoids, and who had always been healthy, having had only whooping cough, measles, chicken-pox, malaria and rheumatism, and who had had eleven children and no miscarriages, and whose history and physical examination showed that the patient was not nervous at the time of her admission to the hospital and had never been so during her life.

For twenty years she had had a double pulsating goiter which had been associated with no symptoms whatsoever.

Owing to her pelvic trouble, she had had some frequency of micturition, but a careful urinary examination made one day preceding the day of operation showed that the urine was absolutely normal, with neither albumin nor sugar present, an acid reaction and with only a few epithelial cells in the sediment.

On the day after the operation the urine was found to be of specific gravity 1.024; it showed some red blood-cells (due to the catheterization of the ureters); and, besides some albumin, contained between 2 and 3 per cent of sugar, tested qualitatively, by Fehling's and the phenyl hydrazin test; and quantitatively, by the polariscopic and fermentation tests. On the next day about 1 per cent of sugar was present, while after the third day, on which a trace was found, no sugar was found in the urine during her subsequent stay in the hospital, although a daily urinary examination was made.

The convalescence was extremely uneventful, the temperature never rising above 99.6° F., and the patient showed rather fewer symptoms of nervousness than one would expect after an operation of such magnitude.

The condition was such a rare one that all the urinary records of the Gynecological Department were carefully examined to see if any other cases of like nature could be found.

Unfortunately in most operative cases there is but little need for a post-operative urinary examination, and there were comparatively few cases in which the urine was examined after the operation.

Two cases of very similar nature to the one I have described were found, however, as the result of this examination.

One of these was a colored woman of forty, who had a large myoma, which had been associated with much hemorrhage and pain, and which had left the patient in extremely poor condition; the expression was very troubled, the patient was very nervous at times, had a poor appetite, and slept very badly. Up to the beginning of the hemorrhages, however, the patient had been very healthy, pleurisy and inflammatory rheumatism ten years before being the only serious illness she had ever had.

The operation was merely an exploratory incision, myoma being found to be absolutely inoperable; the patient was given three hundred and fifty grammes of ether in six minutes. The patient had suffered with burning frequency of micturition for a long while, due to the pressure of the tumor.

the urine examined twenty-seven times previous to the exploratory incision was absolutely normal except for a faint trace of albumin; there was never any sugar present.

The day after the operation, the urine, of specific gravity 1.020, besides containing a trace of albumin, showed a *large amount* of sugar (the exact percentage not given), tested for the fermentation and Fehling's tests.

The next day, however, the sugar had entirely disappeared, there was ever a trace of it again found during the patient's convalescence, which was slow but uneventful, the temperature never rising above 100° F.

The other case was a young woman with an unimportant previous history except that she had always been very nervous, on examination she was found to be of an extremely neurotic temperament. The operation performed was the excision of a retroflexed uterus and the repair of a relaxed vaginal outlet.

The urine, examined on the day previous to the operation, was found to be absolutely normal, while in the urine voided directly after the operation, 0.8 per cent of sugar was found (tested for by the Fehling's and fermentation tests); no trace of sugar was subsequently found in the urine.

None of these three patients gave any history to suggest that a glycosuria might have been present previously, as diabetes, eczema of the genitals, etc.

The exact cause of the transitory glycosuria in these three cases seems to have been, undoubtedly, the inhalation of the ether, *i. e.*, a toxicogenic glycosuria, while certainly in the last two cases the highly nervous character of the patients may have aided materially as a contributory cause, *i. e.*, there was probably a neurogenic as well as a toxicogenic factor.

When we consider, on the one hand, the enormous number of patients that undergo anesthesia, and, on the other, how many of these are nervous, neurotic and hysterical individuals, all of whom the thought of operation would be associated with the most intense emotions, it would seem that this condition should not be so extremely rare, and probably a careful urinary examination made after every operation would result, in some cases, in the discovery of a post-operative glycosuria.

III. MALINGERING MELITURIA.

The third urinary anomaly I wish to report is one which, for want of a better name, I have called "malingering melituria."

The case was admitted to the private ward with the diagnosis of diabetes, made by the physician attending her at her residence. The patient was a young girl of extremely neurotic temperament; in fact she had had several attacks of what was probably hysterical epilepsy, the patient apparently becoming unconscious and assuming remarkable poses.

In many respects she did not have the usual symptoms of diabetes, but the urine seemed characteristic; between 4,000 and 7,000 ccm. of a pale urine of a specific gravity between 1.010 and 1.050 being passed during the twenty-four hours.

The urine showed sugar by the Fehling's reaction, although the reaction did not coincide at all with the quantity one would have supposed to be present from the high specific gravity; with phenylhydrazin but few crystals of phenyl-

glucosazon were obtained, while the quantitative determinations made by the polariscope and the fermentation tube differed markedly; by the latter test the gas was formed extremely slowly, but, after standing a considerable length of time, the amount of carbon dioxide formed showed that there was between one per cent and two per cent of sugar present.

On other occasions in which the urine was examined, the phenylhydrazin and Fehling's tests were negative; by the fermentation test gas-bubbles were formed extremely slowly, while the polariscopic test was positive as before.

The urinary condition was such as to make one suppose that the variety of sugar present was not glucose, at least except for an occasional trace, and the absence of phenylmaltosazon crystals with phenylhydrazin and the dextro-rotatory polariscopic reaction showed that it was neither maltose nor levulose respectively.

It was therefore thought probable that the sugar present might be the ordinary cane-sugar, $C_{12}H_{22}O_{11}$, with occasional traces of glucose mixed with it (due either to a slow inversion in the acid urine, or to the commercial introduction of small quantities of glucose). To determine this definitely, chemically, before attempting to discover its source, the following experiments were performed: The urine was concentrated and boiled with dilute hydrochloric acid for from twenty to forty minutes, when the resulting fluid, after being neutralized with bicarbonate of soda, gave the following reactions: By Fehling's test the reaction was extremely marked and instantaneous, differing in this respect from the much slower and less characteristic reaction or the complete absence of reaction noted before; by the phenylhydrazin test the precipitation of the phenylglucosazon crystals was profuse; by the polariscopic test on the other hand, the plane of polarization was turned slightly to the left; while in the fermentation tube the gas-formation was much more rapid than before and the reaction was more marked than with the original specimen.

All these tests showed conclusively that the sugar present was cane-sugar, the reactions just given depending, of course, upon the fact that cane-sugar when boiled with acids is converted into a mixture of glucose and levulose (one dextro-, the other levo-rotatory), and the reactions given above are exactly those that would occur in such a mixture, while the extreme slowness of fermentation of the original urine is explained by the fact that cane-sugar, in the presence of the yeast-ferment is first converted into glucose and levulose, the former of which then undergoes fermentation. As the girl was extremely hysterical and neurotic, and as the passage of such large quantities of cane-sugar in the urine is practically unknown, it was thought that she herself probably introduced the sugar into the urine.

All sugar was therefore carefully kept off her food-tray, and for a time the sugar entirely disappeared from the urine and the specific gravity dropped to between 1.006 and 1.010, although the polyuria continued.

In a few days, however, the sugar reappeared, although not in such quantities as before; a nurse was then detailed to watch the patient most minutely, when it was found that the patient would slyly remove the lumps of sugar from her tea or coffee and deposit them in the urinary vessel.

When this source was also eliminated, the melituria entirely disappeared, and the patient on being confronted with the evidences of her deception, left the ward in high dudgeon, after absolutely denying what the nurse had plainly seen.

This case, I think is quite unique of its kind, the especially interesting feature, besides the presence of the sugar, being the marked polyuria, a very prevalent urinary condition in very neurotic and hysterical individuals, as well as in diabetics.

In these days when the advertising column of every newspaper is a treatise on diagnosis, and every hillside and vacant lot a manual of therapeutics, it is no wonder that the little and often the distorted knowledge that is so dangerous has proven a fruitful source of hypochondriasis, neurasthenia and malingering among the *οἱ πολλοί*; but so far as I know, this is the first case in which it has brought about a malingering melituria.

The cases in the first and second portions of my article were in the service of Dr. Kelly, and the third in the service of Dr. Osler; both of whom I wish to thank sincerely for allowing me to work up and report these cases of "urinary anomalies."

DISCUSSION.

DR. FUTCHER.—Dr. Brown's cases of post-operative glycosuria following ether administration, call to mind those cases in which the urine contains copper-reducing substances after the administration of certain drugs. In 1875, von Mering and Minkowski found that, after the administration of chloral hydrate to an individual, the urine contained a substance which had the power of reducing alkaline copper solutions. They found that the substance which gave this reaction was urocholic acid in combination with glycuronic acid. Since that date it has been discovered that a large number of medicinal substances administered internally, either themselves, or in some modification, combine with glycuronic acid and are excreted in the urine, giving rise to a reduction of copper solution simulating the reaction of glucose. The more important of these substances are chloroform, morphine, camphor, phenol, resorcin, thymol, menthol and others.

The report of the examination of the urine in Dr. Brown's case indicates, however, that the patient had a transitory glycosuria.

ACUTE LEUKÆMIA IN CHILDHOOD WITH REPORT OF A CASE.

BY THOMAS McCRAE, M. B. (Tor.),

Instructor in Medicine, The Johns Hopkins University, and Physician in Charge of the Clinical Laboratory, The Johns Hopkins Hospital.

The question of the condition of the blood in the anæmias of early life is such an unsettled one, and cases of acute leukæmia in childhood are so rare that every such case is worthy of report in detail. The present case is as follows:

Male; aged 3 years; anæmia; fever; purpuric rash; blood picture of leukæmia; hæmorrhages; convulsions; death; duration about one month.

J. L., male, aged 3 years, was admitted to the service of Professor Osler, in The Johns Hopkins Hospital on May 11th, 1898. The symptoms to which his parents drew attention, were a slight cough and a peculiar area over the sacrum which had almost a gangrenous appearance. The circumstances connected with his admission to the hospital were rather peculiar. His sister was a patient at the time with a surgical complaint, and he was brought from out of the city to see her. He had some cough and interference with his breathing, probably due to adenoids. For this he was admitted, but at the time it was not thought that he had any serious condition.

Family history.—One uncle on the father's side had died of tuberculosis; otherwise the history was negative. There was no history of lues nor anything suggesting it.

Previous history.—He was a large healthy child at birth. He was not breast-fed, but brought up on various artificial foods, combinations of milk, etc. For two months after birth he did not thrive, but afterwards did well until two years old, when he had fever for some time, the nature of which was unknown. Chicken-pox was the only disease of infancy that he had had. In February of 1898—three months before admission—he caught cold and had some bronchitis. With this it

was noted that there were numerous ulcers over the mucous membrane of the mouth. Since this attack he had some cough and obstruction to his breathing. He did not snore at night, but frequently woke up complaining of being choked. About the same time a peculiar bruised area was noted over the sacrum, which was slightly tender. This was thought to have been due to injury. The area did not increase in size and there were no others like it elsewhere. Otherwise the boy had seemed to be perfectly well, with good appetite and digestion.

Present illness.—There were no special symptoms of illness and only the previous conditions were mentioned. To the attention of his parents had given but slight attention, as the boy was thriving and seemed hearty and strong. It was thought, however, that for a day or two previous to admission he had been more easily tired than ordinarily and was rather peevish. He had also complained of some slight pains in the neighborhood of the joints. The boy's father—who was a physician—was positive that until a few days before admission, the patient had been as well as usual and played about with his ordinary vigor.

Examination showed a very stout boy, large for his age, but with a generally pale flabby look which was very striking. He was very bright and intelligent and showed a lively interest in his examination. The mouth was kept open, and the breathing was noisy. The tonsils were much enlarged and there were numerous adenoids present. The gums and mucous membranes were very pale. The shape of the thorax was normal. There were no rickety nodules. The percussive

was clear throughout. The breath sounds were everywhere harsh and accompanied by numerous sibilant and sonorous râles. No tubular breathing was heard. The heart sounds were clear and of normal relative intensity. The abdomen was full and prominent. The edge of the liver was about 3 cm. below the costal margin. The spleen was palpable and hard, although not enlarged beyond the costal margin. There was no tenderness over the abdomen. There was no glandular enlargement. No œdema or signs of rickets were present. Over the sacrum was an area about 5 cm. in diameter, dark purple in color and with a bruised, almost gangrenous look. It felt indurated, was slightly tender and not adherent to deeper structures. No fluctuation could be made out.

The patient remained in the hospital until May 24th, during which time his general condition was as follows:

May 15th. Frequent coughing and constant mouth breathing. His appetite was good and he took his food well.

May 18th. The general condition was worse. There were irritability and restlessness. At times complaint was made of pains in the legs. A small petechial rash appeared on the legs. It was most marked about the knees.

May 20th. He was very fretful and could only be got to take nourishment with difficulty. At times there were severe paroxysms of coughing. There were periods when he became oppressed with great pallor and a very feeble pulse. The purpuric rash persisted. There were many coarse râles everywhere on the chest. The liver and spleen were as before. No enlarged glands were felt.

May 22d. The patient was much weaker. There was no

May 24th. The condition was worse. He was very weak and took but little nourishment. In view of his grave condition his parents decided to take him home to Indianapolis. It was learned that he stood the journey well and seemed better for a day.

His subsequent history was obtained from Dr. F. B. Wynn, Indianapolis, to whom I am also indebted for the account of his blood examination. Dr. Wynn writes as to his condition: "The temperature was from 99° to 100°, pulse 140-160, very weak, respirations 40-50 with considerable dyspnoea, nasal hæmorrhages, several attacks of epistaxis, and on several days nausea and vomiting." Death occurred on May 25th with convulsions which were thought to be due to cerebral hæmorrhage. There was no autopsy.

While in the hospital, his temperature was elevated, usually to 100° and 100.5°. On May 21st it rose to 103.3° and gradually to 99° on the morning of the 24th. The pulse varied from 120 to 160, and the respirations were usually about 40. Dyspnoea was most marked after the attacks of coughing. He did not lose any weight while in hospital. The urine had a specific gravity of 1.015 to 1.020. The reaction was acid and there was neither albumin nor sugar present. The diazo reaction was not given. Microscopically urates and uric acid were found.

Post-mortem.—The first examination after admission was on May 24th. The hæmoglobin was 35 per cent (v. Fleischl), the red corpuscles 1,680,000, and the white cells 26,000 per cmm.

(a ratio of 65 to 1). A differential count of 1000 leucocytes in specimens stained with Ehrlich's triple stain showed:

Polymorphonuclears . . . 13.3 per cent.

Lymphocytes, Small, 41.5 } 86.5 do.
do. Large, 45. }

Large mononuclears2 do.

The red cells did not show any special variation from the normal in either shape or size, and but slight polychromatophilia. No nucleated red cells were seen in counting 2000 leucocytes nor in careful additional search. The lymphocytes showed all variations in size from the smallest up to some which were fully 15 microns in diameter. So many cells were on the border line that the division into small and large is only approximate. The depth of nuclear staining varied much in cells of the same size but the general staining was pale. This was more marked in the larger forms; still, there were but few small lymphocytes with a typical deeply staining nucleus. Cells with nicked or divided nuclei were very rare. The protoplasm about the nucleus was unstained in the majority of the larger forms. One myelocyte was seen. In this, as in the later specimens, there was a marked tendency for the lymphocytes to disintegrate and appear in the stained specimen as shapeless blotches with a pale blue stain. The polynuclear cells in the same specimen would be quite normal. It was found that by making the specimen rather thick, and drawing the covers apart as rapidly as possible, this disintegration could be prevented. Both the small and large lymphocytes showed the tendency to break up.

May 15th. The differential count of 1000 leucocytes showed—

Polymorphonuclears4.4 per cent.

Lymphocytes, small, 78.9 } .95.6 do.
large, 16.7 }

The general characters of the cells were much as on May 12th. There were still all variations in size between the largest and smallest lymphocytes. No nucleated red cells or myelocytes were found.

May 19th. The hæmoglobin was 32 per cent, red corpuscles 1,760,000, and white cells 60,800 per cmm. (a ratio of 29 to 1). The differential count of 1000 leucocytes gave:

Polymorphonuclears4 per cent.

Lymphocytes, small, 96.6 } 99.2 do.
large, 2.6 }

Large mononuclears,3 do.

Eosinophiles,1 do.

The red cells were much the same. No nucleated red cells were found in counting 2000 leucocytes, and in additional search. The lymphocytes were much smaller on the average, and many of them were of the typical small type. No myelocytes were seen.

May 24th. The hæmoglobin and red cells were practically the same as on the 19th, but the white corpuscles had fallen to 21,800 per cmm. (a ratio of 84 to 1). The differential count of 1000 leucocytes showed:

Polymorphonuclears, . . .	.9 per cent.	
Lymphocytes, small, 89.2	} 98.6 do.	
large, 9.4		
Large mononuclears, . . .	.4 do.	
Eosinophiles, . . .	.1 do.	

The general characters of the cells were as before, but the red cells showed somewhat greater variation in staining. No nucleated red cells or myelocytes were seen.

Dr. Wynn very kindly sent me his count taken a few days later in Indianapolis. The hæmoglobin was 30 per cent (Gowers), red corpuscles 1,800,000, and white 36,000 per cmm.

In considering this case a striking feature is the rapid course. The patient was admitted to the hospital almost accidentally—if one may so term it—on May 11th, and beyond the presence of enlarged tonsils and adenoids he seemed, on superficial examination, to be in ordinary good health. Had it not been for the results of the blood examination, no suspicion of leukæmia would have been entertained. There were no symptoms pointing to acute disease, and his father was sure as to his having been in his normal condition up to a few days before. From the time of admission to the hospital until death was less than three weeks. Including the few days of malaise previously the whole course was not over four weeks. Even when the first blood examination was made, the possibility of the case being one of extreme lymphatism was considered, although the high percentage of lymphocytes (86.5) suggested leukæmia. In his condition any attempt to remove the adenoids and enlarged tonsils was thought inadvisable, even though they caused considerable obstruction. About May 18th the general condition changed and the symptoms were more severe. The blood showed 99.2 per cent of lymphocytes and the hæmorrhagic rash had appeared. The temperature ranged higher and from this to the time of discharge the downward course was rapid. Death, as already noted, occurred on May 30th.

In regard to the blood condition a relatively high proportion of the hæmoglobin to the red corpuscles is seen. The color index on the first examination was slightly over 1, falling a little below it subsequently. A high-color index, while usually characteristic of pernicious anæmia, occurs not infrequently in other blood conditions. In a recent case of lymphatic leukæmia in this hospital the color index was always about 1 during observations extending over a period of two months. In two recent cases of splenic anæmia the same ratio was observed. It will be noted that there was practically no diminution in the number of red cells during the course of the disease. In the stained specimens they showed but little variation from the normal throughout. Variations in the staining were rather more marked. No nucleated red cells were found at any time, although special search was made for them. In all the specimens the same difficulty was found in obtaining satisfactory slides. Unless the covers were drawn apart very rapidly, the majority of the lymphocytes were irregular masses without any definite outline. They took the stain exactly as the nuclei in the better specimens. This tendency to disintegration may be a feature of the lymphocytes in acute cases. So far as known there are

not sufficient observations to speak with certainty on this point. The staining of the nuclei of the lymphocytes showed great variation, although the prevailing stain was a pale one and this was most marked in the larger forms. The lymphocytes showed increase both absolutely and relatively. The polymorphonuclears showed an absolute reduction. On admission they were 3400 per cmm., but fell later to 200 and 180 per cmm. The eosinophiles were absent in the earlier counts, and 60 and 21 per cmm. were found in the later ones.

Leukæmia is a relatively rare disease in the first decade. Cassel¹ states that among 3000 autopsies in Friedrichshagen there were only two instances of leukæmia below the age of ten years. Considering acute leukæmia, however, there seems ground for thinking that it occurs in a somewhat larger proportion. Theodor² collected 45 cases of acute leukæmia of which 6 were in the first decade. There were 5 between the ages of 10 and 15 years. Fussell and Taylor³ have published a series of 56 cases, among which 9 were in this period. Morse⁴ in reporting a case in 1898 collected 7 from the literature. There is doubt expressed as to cases reported some years ago, but apparently 13 previously reported cases may be accepted. A recent case in an infant reported by Pollman⁵ is not included, as the condition appears to have been considered congenital. Bloch and Hirschfeld⁶ report a case in a boy aged eight months, which was probably acute, but the exact duration was not known. The present case is the fourth to be reported within a year. The previous cases are as follows:

I. Keating⁷. Female, aged 4½ years; epistaxis, fever, hæmorrhagic rash, cervical glands and spleen enlarged. The blood was examined by Dr. Osler. The red cells were normal, nucleated cells being seen. The whites were very numerous there being 50 or 60 in one field. They were largely lymphocytes. Duration 9 weeks; type probably lymphatic.

II. Wadham⁸. Male, aged 5 years; no hæmorrhages, slight fever, cervical glands enlarged, abdominal pain and distention. The type can not be decided from the description given. Duration 8 weeks. Autopsy.

III. Guttman⁹. Male, aged 10 years; a previous history of enlarged tonsils and adenoids, hæmorrhages, hæmorrhagic rash, no fever, hemiplegia, priapism, spleen and liver enlarged. The blood showed whites to reds as 1 to 1.4. Type was probably lymphatic. Duration 4½ days. At autopsy the thymus was found much enlarged.

IV. Eichhorst¹⁰. Male, aged 8 years; onset sudden with precordial pain, hæmorrhages, fever, enlarged spleen and liver, no swelling of the lymph-glands. The blood showed 88,000 whites. No nucleated reds were seen. Duration 2 weeks. Autopsy. Lymphatic in type.

V. Müller¹¹. Male, aged 4 years; hæmorrhages, ulceration of throat and only the cervical glands enlarged, liver and spleen enlarged, fever. The blood showed 109,000 whites, which 97 per cent were mononuclear, with an acute staphylococcus infection. Shortly before death the leucocytes fell to 6800. Duration 5 weeks. Lymphatic in type. Autopsy.

I. Müller¹¹. Male, aged 4 years; hæmorrhages, hæmorrhagic rash, fever, liver and spleen enlarged. The blood showed 209,000 white cells of which 98 per cent were mononuclear. Duration 4 weeks. Type lymphatic. No autopsy.

II. Goldschmidt¹². Male, aged 2½ years; cervical glands enlarged, liver and spleen enlarged, fever, nephritis. Blood picture of leukæmia. Nucleated red cells present. Duration 6 weeks. Autopsy. Lymphatic in type.

III. Theodor². Male, aged 4 years; luetic family history, hæmorrhages, cervical glands enlarged, spleen enlarged, liver enlarged; no fever. The white cells were to the reds as 1 to 9. Nucleated red cells were present. Duration 6 weeks. Lymphatic in type. No autopsy.

X. Cabot¹³. Infant; lymphocytes over 98 per cent, duration 6 weeks, lymphatic in type.

IV. Morse⁴. Female, aged 3 years; hæmorrhages, enlarged tonsils, liver and spleen enlarged, general glandular enlargement. The duration was not more than 7 weeks, and probably less. The type was lymphatic. No autopsy.

V. Bradford and Shaw¹⁴. Male, aged 7 years; hæmorrhages, fever, swelling and ulceration of the mouth, cervical glands enlarged, spleen enlarged, liver not. Duration probably 7 or 8 weeks. Autopsy. Lymphatic type.

VI. Haushalter and Richon¹⁵. Male, aged 7½ years; hæmorrhagic rash, no fever, glands and spleen enlarged, blood cultures yielded streptococci. Duration 8 weeks. Autopsy. Lymphatic type.

VII. Bradley¹⁶. Male, aged 8 years; hæmorrhages, hæmorrhagic rash, liver and spleen enlarged. The white cells were 85,000, of which 97 per cent were lymphocytes. There were a few nucleated red cells present (personal communication from Dr. Bradley). Duration 7 weeks. No autopsy. Lymphatic type.

It is of interest to compare the symptoms in this series of cases. As in case IX only the blood features and duration are known, it is not considered in the figures given for various other symptoms.

Family history.—There is nothing of any importance under this heading. In only one case was there a luetic history, and in one a tuberculous family history.

Previous history.—Various infections are noted in the previous histories of the cases. One had had meningitis, one had had suppuration of the cervical glands, and three had suffered from some affection of the tonsils. This last is of some importance in connection with the number of instances in which the disease was accompanied by acute tonsillitis.

Sex.—A large proportion of the cases were in males, namely 11 out of 13. This is true of acute leukæmia at all ages. In the series of Fussell and Taylor, among 55 acute cases where the sex was known, 33 were males. The same is true in leukæmia generally in childhood. Thus, Birch-Hirschfeld, among 39 cases below the age of 15 years, found 25 males and 14 females. This applies to cases from the first years.

Onset.—This was sudden in many of the cases as might be expected from the rapid course. In one case, No. VIII, the first symptom was hæmorrhage following a fall from a horse. In four cases hæmorrhage was the first prominent symptom.

Hæmorrhages.—These occurred in 10 cases. The bleeding was from the nose, mouth, stomach, bowels and kidney. In no case did the bleeding seem to have been sufficient to cause death directly. A hæmorrhagic rash was present in 10 cases, of which 9 had also bleeding from a surface.

Fever.—This was noted in 8 cases, its absence in 4, and in 1 there was no note. The temperature was usually not extremely high. The highest was in No. XI, where it rose to 105.4°. In this case blood cultures taken at this time were negative.

Glandular Enlargement.—General enlargement was noted in 4 cases, enlarged cervical glands only in 5 cases, no enlargement in 2, and no note in 2 regarding it. In the cases with enlargement of the cervical glands only, this was usually associated with local throat or mouth conditions such as enlarged tonsils, adenoids or ulceration.

Spleen.—This was enlarged in all the cases. The degree was not great, the edge usually being 3 to 4 cm. below the costal margin.

Liver.—There was enlargement in 8 cases, none in 3, and in 2 the condition was not noted. In no case was the enlargement extreme.

Miscellaneous Symptoms.—Pains in the joints and bones were noted, hemiplegia, priapism, etc., but none in any large proportion of the series.

Blood.—There was marked anæmia in all the cases in which blood examinations were made. Among the eight cases in which the corpuscles were counted the highest count was in No. VI, viz., 2,350,000 and the lowest of 1,000,000 in No. IV. The percentage of hæmoglobin varied from 40 in No. V to 18 in No. II. The degree of anæmia in these acute cases is striking. It suggests the possibility of the development of the disease in children already anæmic. The red corpuscles did not show any rapid fall while the cases were under observation. If such low counts were suddenly brought about by the disease, it would seem probable that the rapid fall would continue with the advance of the other symptoms. If the onset of the disease were attended with such rapid blood destruction, why not the terminal stages? An explanation may be that these children had been suffering from leukæmia in a more chronic form for some time and that what we consider the whole course was only an acute exacerbation at the termination. The histories of these cases and the consideration of the marked general features do not support this view. The question is an interesting one, and may be answered when cases have been observed with blood counts taken prior to the onset of any symptoms.

The high-color index in the present case has already been commented on. A color index over 1 was shown in 4 cases of the series, Nos. IV, V, XIII, XIV. When the color index was below one, as in three cases, Nos. VI, X, XII, it was only about .5. This relation of the hæmoglobin to the red cells divides the cases into one class with the blood of a pernicious anæmia type, and into a second with the characters of a secondary anæmia. As already stated a similar point has been noted in a series of cases of splenic anæmia. So far as can be gathered from the descriptions given, no difference was observed in the shape and size of the red cells in these two groups. In spite of the severe anæmia the red corpuscles as a

rule showed little variation from the normal in their characteristics. This may be due to the acuteness of the condition as in a case of pernicious anæmia at present under observation in which the symptoms developed with great suddenness. It was fully two months after the onset before the red cells showed any special variation in size, shape or staining. In 10 cases of this series it was noted that the red cells showed no marked changes from normal in their general characters. In the remaining 3 cases there was no note on this point. The occurrence of nucleated red corpuscles is an interesting question. The statement is made by some writers that cases of leukæmia in children show more abundant nucleated red corpuscles and that megaloblasts are usually equal in number to normoblasts. The cases of this series do not seem to support the view that nucleated red cells are common in acute leukæmia in childhood. Thus among 11 cases in which full descriptions are given, no nucleated red cells were found in 7, and in the 4 cases where they were found the numbers do not seem to have been large. In only one case, No. VIII, was the occurrence of megaloblasts noted. In this instance their number increased while the patient was under observation.

White corpuscles.—The number of the leucocytes shows wide variation. There are counts in 8 cases, the highest being 209,000 in No. VI, and the lowest 21,000 in the present case. The characteristics of the white corpuscles are much the same in all the cases. In some only a general account is given but sufficient to recognize the prevailing type of cell. In all there is an absolute and relative increase in the mononuclear elements. The proportion of large to small cells varies in the different cases. There does not appear to be any relation between the varying proportions of large and small forms and the relative acuteness of the disease. The mononuclears in all the described cases showed great variation in their staining. The largest absolute number of mononuclear cells was in No. VI, where they numbered 204,800 per cmm. The absolute number of the polymorphonuclear leucocytes was about normal in most of the cases. The highest number per cmm. was in No. XI, where they were about 15,000 on one occasion and 8800 on another. The lowest number was in the present case, where on admission they were 5400 per cmm., falling later to 240 and 180. Myelocytes were rarely seen and were only noted as of very occasional occurrence.

Type of Leukæmia.—This is apparently lymphatic in 13 cases, and in the remaining case no note regarding the blood is given. This is in accordance with the acute course of lymphatic leukæmia generally as compared with the splenomyelogenous type. There are instances of the latter variety in children.

Duration.—The period of nine weeks has been generally accepted as the limit of time within which a case should be considered acute. While the general features of the case should also be considered in classing a case as acute, still it will be found that nearly all cases with acute features terminate in this time. Müller,¹¹ in reporting the two cases noted before, has also described a case with a duration of 13 weeks, which, in its general features, might be termed acute. The duration in 4 cases of this series was less than one month, and in 10 was between four and nine weeks.

General features.—These cases show some agreement in their features beyond the acute course. The disease occurs usually in a male with no special feature in his family or previous history except perhaps a history of throat trouble. This was marked in some instances and suggests possibly something of a causal relationship. In one, No. XI, emphasis is laid on the presence of carious teeth. Possibly this condition had been more often looked for, it might have assumed more importance as a possible causal source of infection. Hunter¹⁷ has recently raised the question of possible association between foci of infection in the mouth—such as carious teeth—and pernicious anæmia, considered as a chronic infective disease. A possible relationship to the so-called "Lymphatic Constitution" must also be considered. This has been discussed by Ewing¹⁸ who considers that there is no direct indication of connection between that condition and leukæmia. That children with the lymphatic constitution are more apt to develop leukæmia we can not say. One of the series, No. III, showed a much enlarged thymus at autopsy.

The onset is usually with moderate suddenness; fever is present in a majority of the cases with hæmorrhages and hæmorrhagic rash. General glandular enlargement is found in less than half of the cases; in more the cervical glands alone show enlargement. The spleen was enlarged in every case where there are notes of an examination and the liver also in more than half of the series. In all, the anæmia is a striking feature, and the symptoms of the disease may be summed up as a severe anæmia with frequent multiple hæmorrhages, fever, enlargement of the spleen and frequent enlargement of the liver. In some cases general glandular enlargement but in others only of the cervical glands, enlarged tonsils, ulceration of the mouth, pains in the bones, etc., are present. With these is a downward course to a rapidly fatal termination. Guinon and Jolly¹⁹ in discussing the subject divide the cases into three classes:

1. Typical forms: swollen glands; anæmia; termination in hæmorrhages.
2. Hæmorrhagic form: features of an infectious purpura.
3. Pseudoscorbutic: lesions of the mouth, gums and tonsils predominate.

Diagnosis.—This can only be made with certainty through the examination of the blood. In nearly all the cases emphasis is laid on the striking anæmia. This with the severe general symptoms and the occurrence of hæmorrhages should suggest a blood examination. Probably the conditions with which it is most apt to be confounded are: (1) an acute infection with specially marked throat symptoms, and (2) a hæmorrhagic purpura. Bradford in referring to his cases has laid emphasis on the probability of considering an acute leukæmia to be merely an infection unless a blood examination be made. Probably, with more frequent routine work on the examination of the blood, cases will be found more often.

Treatment.—This can only be symptomatic with our present knowledge. In no case does any treatment appear to have been of any service.

In conclusion, emphasis may be laid on the necessity of a careful study of the anæmias of early life. The subject

present is in a rather chaotic state, and only through careful blood examinations can we hope to have the lines drawn more satisfactorily.

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PERSONAL EXPERIENCE IN OPERATIONS FOR STONE IN THE BLADDER.*

BY A. T. CABOT, A. M., M. D.

Not many years ago, a leading surgeon of the West, going through the Massachusetts General Hospital, pointed to the Bigelow instruments and asserted that in a few years litholapaxy would be an operation of the past.

I would ask you to contrast with this opinion the experience and practice of English surgeons in India. Those men, who see more stones in a year than many of us do in a lifetime, are earnest and enthusiastic advocates of litholapaxy. Indeed, it was an Indian surgeon who extended the scope of the operation to the treatment of children.

Which of these opinions is most in accord with the facts? Is litholapaxy being superseded by other methods of stone-removal and becoming obsolete or not? Ought it to be so superseded? These are the questions that I wish to discuss with you in the light of what experience I have had.

In considering the comparative value of these operations, we have to take account of the death-rate which accompanies each, of the injury to important structures which each involves, and of the liability to a recurrence of stone-formation which follows each.

A statistical study of these questions from cases reported by other operators is difficult and of little value. Many surgeons use litholapaxy for their easy cases, where the stone is small, and cut for their larger stones, in which a longer duration and severity of the disease has presumably led to serious secondary changes in the urinary organs. Such a practice

would give litholapaxy an unfair showing over the operations resorted to in the more serious cases.

Again, in many of the cases of suprapubic incision for stone, the operator removes a portion of the prostate or digs the stone out of a pocket, so that the operation ceases to be a simple lithotomy.

When we come to an examination of the question of injury to the parts about the neck of the bladder, it is often impossible for the surgeon who operates to follow his patient in after life and ascertain the extent and remote consequences of such injury. Cases occasionally come to the notice of all of us in which an incision made in childhood has led to impotency, not discovered until after puberty was established, or even much later. I have met with at least two cases in which a perineal lithotomy has been followed many years later by a narrowing of the urethra sufficiently close to cause symptoms of stricture, and in one of these a pachydermia vesicæ, and, finally, a carcinomatous condition of the bladder, developed.

Lastly, in judging of the frequency of stone-recurrence, the difficulty is even greater; and one is constantly compelled to revise his own statistics, as cases supposedly cured reappear with a return of symptoms. How often this recurrence occurs in cases reported by others, it is difficult to say; but, judging from my own experience, it must happen more often than published statistics would lead one to suppose.

For these reasons I propose to depend, as far as possible, on my own experience for the facts from which I draw the conclusions I shall present. I shall endeavor to give this experi-

* Read at the meeting of The Johns Hopkins Hospital, April 10, 1900.

ence in a sufficiently explicit manner to enable others to judge how far my deductions are supported by reliable observation.

The stones I have met with in my practice have been, as a rule, secondary to enlargement of the prostate. Many of them, in fact the majority, have been phosphatic stones, dependent upon the cystitis set up by the enlargement of the prostate. Even the uric-acid stones which have occurred in these cases have usually been in part due to the incomplete emptying of the bladder, owing to the obstruction.

The average age of these patients has been somewhat over sixty years. The material, therefore, from which I have derived my experience, has been as unfavorable to success in stone-treatment as is possible; for most of the operations have necessarily been done in bladders already diseased, often too, in cases where the kidneys were more or less affected.

Litholapaxy has been the operation of choice in all of my cases, irrespective of the size of the stone or the condition of the patient, except in a few instances when, for some reason, it could not be used or when some other condition compelled a cutting operation and the removal of the stone was merely an incident in this. Thus, in operations for stone I have done litholapaxy 122 times, suprapubic lithotomy 12 times, and perineal lithotomy once.

The suprapubic operations were selected in two cases because the lithotrite would not enter the bladder without an undue exercise of force. In six cases the operation was primarily a prostatectomy, and in one case the coexistence of a myoma of the bladder-wall compelled us to make the suprapubic incision. In two cases the stones were sacculated and could not be reached by the lithotrite. In one case the stone was so large that the lithotrite, when grasping it, would not lock.

I find that out of the one hundred and twenty-two litholapaxies six patients have died within a comparatively short time after the operation. In order that you may judge of the degree in which the operation was responsible for the deaths, I will briefly report these cases.

The first death occurred in a man sixty-nine years of age, upon whom I operated in 1885. The patient was feeble and had a weak pulse. The condition of the urine, however, was reasonably good, showing nothing beyond alkaline fermentation, and it was passed in good amount. The patient, however, had a troublesome cough with profuse purulent expectoration. The stone was small and soft, weighing only 98 grains and the operation was in no way difficult. The patient was wholly relieved of his urinary symptoms by the removal of the stone, the urine became acid, and almost wholly cleared of pus. In the meantime, however, his cough became much worse. On the fourth day after the operation he began to have considerable dyspnoea, and presently an examination of the lungs revealed the presence of pneumonia, secondary to the bronchitis which had existed previous to the operation. He died on the tenth day following the operation.

The second patient was an old man who had complete obstruction of the prostate so that for some time the urine had been drawn by suprapubic aspiration. The aspirating needle touched a stone and I was then called to the patient. At the time that I saw him the urine was suppressed, so that the contents of the bladder at the operation consisted almost

wholly of stringy mucous. The operation was done as a desperate effort, without much hope of its success. A large oxalate-of-lime stone was crushed and pumped out. The kidneys never resumed their function after the operation and the patient died about twenty-four hours later.

The third patient was a broken down man of sixty years who had a chronic bronchitis, with a feeble heart. He entered the Massachusetts General Hospital on account of extreme pain in the bladder and frequency of urination. A stone had previously been touched before he was sent in. The condition of his lungs and heart was so wretched that he was kept in the Hospital two months while everything possible was done to improve his condition and get him to the point of bearing the operation. The urinary difficulty and pain, however, were so excessive that he got little sleep and did not regain any strength. A quick litholapaxy was, therefore, finally done under ether. The operation did not take long and was not especially difficult. The patient, however, developed a great increase of difficulty of breathing immediately following it and died three days after the operation.

The fourth case was that of a woman sixty-two years of age. A hard stone weighing a little over an ounce was removed by litholapaxy and at the same time, some glands in the neck, which were extensively tuberculous, were curetted. The patient did very well for a time. The temperature fell to normal and recovery seemed assured, when she gradually began to fail and died six weeks after the operation, death being due to the tuberculosis and not in any way to the operation on the bladder.

Case 5 was a man eighty-four years of age who had suffered for a long time from urinary symptoms, believed to be due to enlargement of the prostate. A catheter, which was tied in his bladder was so worn upon one side that it became evident that there must be a stone there pressing upon it. I etherized and examined him. There was a large stone, in fact I thought there were several stones, in the bladder, which were crushed and pumped out. This operation relieved his pain in great measure, but for three weeks following the operation the temperature was irregular and the general condition of the patient rather unsatisfactory. This was ascribed to pyelitis and possibly pyelonephritis. Finally, on the twentieth day after the operation, the temperature fell to normal and remained so until the twenty-seventh day. The patient was now suddenly taken with severe dyspnoea with symptoms pointing to the chest, and quickly died. An autopsy was not allowed, but it seemed quite clear that the final cause of the death was pulmonary embolism, which came at the time when he was practically recovered from the immediate effects of the operation.

The sixth case was that of a feeble man of seventy who entered the Hospital with a history of having had symptoms of stone for six months. The operation was an easy one and the patient seemed to be reasonably well after it. Death occurred suddenly and unexpectedly on the third day. The autopsy showed a condition of pyelitis and pyelonephritis, although no cause for the suddenness of the death could be discovered.

It would be certainly a contradiction of fact to ascribe the death in the fourth case to the operation.

In Cases 1 and 3, the fatal outcome did not in any way result from the manipulations of the operation, but was probably dependent on the irritation to the lungs of the anæsthetic employed.

Cases 2 and 6 died, in spite of the operation, of the condition of the kidneys which already existed at the time of the litholapaxy.

In Case 5, the pulmonary embolus may have come from the pelvic veins and have been, therefore, an indirect result of the operation. I remember one fact bearing upon this point and that is, that in one case, which subsequently recovered, I saw a phlebitis of one leg following a secondary washing of the bladder, done ten days after a litholapaxy. This shows that the pelvic veins may occasionally become inflamed from the irritation caused by the use of urethral instruments.

If all of these cases, except the one that died of tuberculosis, be counted as deaths from litholapaxy, we have a mortality of 4 per cent.

Every one of the patients who died was in a seriously damaged state before the litholapaxy and the outcome was to be ascribed to an aggravation of antecedent conditions rather than to any damage inflicted by the operation.

As far as this experience goes, then, we have the right to feel that a litholapaxy on a tolerably healthy subject has practically no risk.

Further than this, a study of my cases shows that among them were a number of patients who were passing large quantities of urine of low specific gravity and several that had shown digestive disturbances suggestive of mild uræmic conditions.

Such patients are, according to my experience, very unfavorable subjects for lithotomy or any extensive cutting operation, and yet, with one exception (Case 6 just reported), they did well after litholapaxy.

Could any of the patients who died have had a better chance by any other operation?

I think that possibly this question should be answered in the affirmative, in regard to two of them; for, at the present time, instructed by some excellent work, done here at Johns Hopkins Hospital, should I again have a case of stone in a man suffering from serious bronchitis, I should be inclined to prefer a suprapubic lithotomy, done under cocain anæsthesia, to a litholapaxy.

My friend, Dr. Chismore, of San Francisco, would doubtless in such a case do litholapaxy under cocain anæsthesia; but I have had such difficulty in producing a satisfactory anæsthesia of the prostate and bladder in this way, that I should prefer the quick cutting operation.

DIFFICULTIES MET WITH IN THE OPERATION.

I have had two cases, already mentioned, in which the enlarged prostate so resisted the passage of the lithotrite that I was obliged to resort to a suprapubic operation. These are the only instances in which I have had to abandon an attempt at litholapaxy.

A strictured nrethra adds little difficulty to the operation. If it yields readily to divulsion, the canal thus enlarged can

be easily traversed by the litholapaxy instruments, and I have done many operations in this way.

When a tight stricture exists in the perineum, urethrotomy may be done and the opening thus made may be utilized for the litholapaxy. A perineal litholapaxy is an easier operation than where the instruments have to traverse the whole length of the nrethra. With the patient in the lithotomy position the stone rolls back towards the fundus of the bladder where it is easily reached, and through the distensible deep urethra large instruments can be readily used.

In the whole series of litholapaxies I have had but one serious accident. This was a rupture of the bladder and has been fully reported. I will here only say that the bladder was very intolerant and spasmodic; so much so that I introduced but two ounces of fluid before using my lithotrite. The stone was a very small one, and was caught and crushed at once without any difficulty. During this procedure the water was kept in the bladder by a rubber band around the penis. A constant oozing of fluid through the interstices of the instrument showed how great the pressure in the bladder was. When the tube was introduced it was at once found that the water, which went in without resistance, did not return, and it was, therefore, evident that the bladder had ruptured itself. An immediate laparotomy showed that the rupture was extraperitoneal, and that the effusion was under the peritoneum on the left side of the pelvis. This collection of fluid was drained by an incision similar to that for tying the iliac artery, and a drainage tube was also introduced into the bladder through the perineum. The patient recovered, but always continued to have an excessively irritable bladder.

As it is well known that the bladder has been frequently ruptured when distended in a suprapubic operation and that even the rectum has been similarly damaged by the Peterson's bag, it will be seen that this accident is in no way peculiar to the operation of litholapaxy. In fact, the introduction of fluid in litholapaxy is so constantly under the control of the surgeon's hand that he is able to accurately judge of the degree of distention. It is, therefore, an accident which must occur but rarely, and then only when extremely thin-walled diverticula exist.

The fear that many surgeons have of nipping the bladder-wall with the lithotrite has little, if any grounds.

When the bladder contains a proper amount of fluid, its walls are gently stretched, and it is almost impossible to catch them with the instrument, even if the effort is made to do so. The danger may be wholly avoided by operating in the centre of the base of the bladder. When the heel of the instrument rests at this point, the bladder-walls do not fall into the blades and sufficient space is given for easy manipulation of the instrument without touching them.

INJURY DONE BY OPERATIONS.

I have known of no serious or lasting injury following a litholapaxy. The irritation following the operation quickly subsides, and leaves the patient nowise worse for the operation.

Suprapubic lithotomy avoids important structures, but occasionally leaves an annoying and obstinate fistula. Perineal lithotomy, by which I mean the lateral incision, has the dis-

advantages, already alluded to, of occasional impotency, occasional stricture, and rarely of fistula following it. I have seen instances of all of these sequelæ, so that litholapaxy has a decided advantage in the avoidance of injury.

RECURRENCE OF STONE.

Among these patients are two instances in which a uric-acid stone has re-formed in consequence of the persistence of the diathesis that led to its original formation. On one of these patients I operated twice, and upon the other three times.

There are nineteen instances in which a phosphatic stone has appeared some months or years after the removal of a primary stone. In two or three instances the primary stone was a uric acid calculus; in all other cases it was phosphatic.

In six of these cases, the previous operation had been done by some other operator.

This recurrence of a phosphatic stone may be due to the persistently alkaline condition of the urine. Several instances of this sort have come to my notice, the most striking of which was a case of multiple calculi in which, within a fortnight of a thorough washing out, the bladder would contain from fifty to one hundred little, separate, well-formed stones. This tendency was finally overcome by frequent pumping out of the calculi, combined with medical treatment directed to making the urine acid.

In two or three cases the recurrence may perhaps be regarded as the result of an incomplete operation, leaving a fragment to serve as a nucleus for a new stone. This accident has usually been avoided by care in washing out the bladder with the evacuator ten days or a fortnight after the litholapaxy. In some cases several washings have been necessary before the bladder was found to be entirely free from calcareous matter.

In one case, of a woman, the projection into the bladder of two stitches put in by two other surgeons, for the closure of the opening made in doing a vaginal lithotomy, led to the repeated recurrence of calculi until the stitches were found and removed.

In two cases sacculated stones which lay concealed in pockets in the vesical wall gave rise to repeated stone-formation in the bladder-cavity. The removal of the stones loose in the bladder was followed in each case by such a cessation of symptoms that the presence of the encapsulated calculus was not suspected, but it was finally found by a cystotomy done for the purpose of discovering the condition to which the recurrence of the stone was due.

Finally, certain local conditions of the bladder-wall favor the formation of stone and lead to constant recurrences until they are removed.

It is notorious that tumors and granulating surfaces within the bladder are prone to be encrusted with salts. The crystallography of stone-formation is interesting in connection with these cases of calcareous deposit on granulating surfaces.

The crystals that exist in the urine do not tend to cohere and form a stone except in the presence of albuminous material. Rainey showed many years ago that the presence of colloid or albuminoid substances in a solution causes crystalline materials to become spheroidal in shape and to coalesce

in rounded form. This is the law of molecular coalescence which has a very decided bearing upon stone-formation in the bladder.

As long as the urine is non-albuminous, crystals of uric acid or oxalate of lime may form in the urinary passages, be washed along and discharged with the urine without forming a stone. But when albumin is present, either in the pus thrown out in consequence of some irritation or in the serum exuding from a granulating surface, we have conditions favorable to "Molecular Coalescence."

It has frequently been urged by advocates of cutting operations that recurrence of stone is especially prone to occur after litholapaxy, owing to incompleteness in the operation. My experience does not coincide with this view; for the cases of recurrence after litholapaxy have, with one or two exceptions, been shown to be due to a general diathesis or to the local conditions described above. The suprapubic operation, too, is far from being exempt from the opprobrium of failure to prevent recurrence of calculous formation.

I have had one case in which a stone followed a prostatectomy, and in four instances have seen stone-recurrence after suprapubic removal.

But why, it will be asked, should a suprapubic operation, which gives opportunity for the most thorough cleansing of the bladder, leave behind it a tendency to stone formation?

I think the reason for this is that wounds of the vesical wall do not heal immediately by first intention, but are very apt to leave a granulating spot for a greater or less time; and such a surface, as we have seen, is prone to become encrusted with calcareous material and so serve as the nidus for a new stone.

On one or two occasions after a suprapubic operation, I have washed out the bladder with the result of obtaining a little calcareous matter which presumably had been deposited upon such granulating spots.

In 1889, writing upon the Choice of Operation for Stone in the Bladder, I stated as my belief that litholapaxy should be employed except in the presence of one of the following conditions:

1. A very large and hard stone may resist every attempt at crushing, especially if it is tightly grasped by the spasmodically contracted bladder.
2. A stone may have as a nucleus a foreign body, such as a piece of necrosed bone or a bullet, too hard to crush and too large to pass out through a tube.
3. An encysted stone may be out of reach of the lithotrite.
4. False passages may exist, which so interfere with the introduction of instruments that the dangers of the operation are greatly enhanced, and the question of lithotomy is to be entertained.
5. The hip may be ankylosed in a position which interferes with the use of urethral instruments.
6. A stone may be so lodged in the prostatic urethra, that it cannot be pushed back into the bladder where it can be seized by the lithotrite.
7. When the constant recurrence of the stone makes it seem probable that an ulcerated patch exists in the bladder

and is leading to a calcareous deposit, the suprapubic operation is required for the removal of this local condition.

8. In the presence of an obstructing prostate the suprapubic incision will sometimes be advisable, with the object of removing the obstruction. The removal of the stone is merely an incident in this operation.

I have seen no reason, with added experience, to change this opinion except as far as is set forth in this paper, in relation

to cases of coincident bronchitis or other condition making etherization dangerous.

I feel that a mortality of four per cent. in a series of cases averaging sixty years of age, is considerably less than could be expected from suprapubic lithotomy in a similar class of patients, and that the avoidance of fistulæ and the shortened convalescence add decided advantages to this method of operating.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

SAMUEL THEOBALD, M. D. A Case of Extensive Detachment of the Retina in a Myopic Eye, in which Complete Recovery followed Rest in Bed and the Administration of Pilocarpin. —*Archives of Ophthalmology*, Vol. XXIX, No. 1, January, 1900.

The treatment was begun within four days of the occurrence of the detachment, and to this fact the successful outcome of the case, perhaps, in considerable measure, to be attributed. The detachment was so extensive as to preclude an ophthalmoscopic view of the papilla, and sight was reduced to ability to detect movements of the hand in the upper and outer portion of the field. Pilocarpin muriate was given by the mouth in increasing daily doses, beginning with gr. $\frac{1}{8}$ for nineteen days, the maximum dose reached being gr. j. The patient was confined to bed for two weeks, and kept in the hospital for five weeks. The administration of the pilocarpin was followed by five-grain doses of potassium iodid. Within five weeks of the commencement of the treatment the retinal detachment had markedly diminished, and at the end of three months it had entirely disappeared. V gradually improved to $\frac{20}{1x} +$. When last seen, fourteen months had elapsed since the detachment of the retina, and there were no signs of a recurrence of the trouble.

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— Affections of the External Ear.—*American Text-Book of Diseases of the Eye, Ear, Nose and Throat*, 1899.

— Report of One Hundred Consecutive Cases of Cataract Extraction. *American Journal of Ophthalmology*. Vol. XVI, No. 12, December, 1899, pp. 353-375.

The cases were in no sense selected, but included two eyes which had previously been iridectomized for glaucoma, two in which there was dislocation of the lens of traumatic origin, one in which there was myopia of high grade with detachment of the retina, three in which the cataract was secondary to syphilitic iridochoroiditis, one in which the lens was shrunken and the iris adherent to its capsule, and one myopic eye in which there had occurred previously an attack of iridochoroiditis.

The operations were divided as follows :

Extraction with iridectomy.....	52
Extraction after preliminary iridectomy	
(usually accompanied by trituration of lens).	26
Simple extraction.....	20
Extraction of dislocated lens in capsule.....	2
	<hr/>
	100

The results obtained are summarized as follows :

Successes ($V = \frac{20}{cc.}$ to $\frac{20}{xiii}$).....	83
Successes (V not recorded)	7
Total Successes.....	<hr/> 90
Partial Successes ($V = \frac{16}{cc.}$ to $\frac{11}{cc}$).....	4
Partial Successes (V not recorded)	2
V not improved (though recovery from operation was smooth)	2
Losses (from suppuration).....	2
	<hr/> 100

Of the two eyes lost by suppuration, one was a highly myopic eye, in which the operation was completed without accident ; the other an eye previously iridectomized for glaucoma, in which the lens capsule was very tough, and the vitreous humor the consistency of water, and in which during the efforts to extract the lens the whole contents of the vitreous chamber escaped, and the eye collapsed. There were five other cases of escape of vitreous, but in these the loss was inconsiderable, and the success of the operation was not impaired. There were seven well-marked cases of iritis. In 27 cases a secondary operation (discission of capsular opacity) was performed (and in three of these a repetition of the discission was required). In no instance was it necessary to perform a secondary iridectomy or iridotomy.

There were no losses among the 20 cases of simple extraction, and, as to visual results, all were successes except one, in which the rather poor sight obtained ($\frac{15}{cc.}$) was due to retinitis hæmorrhagica. There were among them, however, 3 cases of prolapse of the iris, and, while only 2 of these were so extensive as to require abscission, they induced, the author tells us, "A lack of confidence in the method, the outcome of which has been an adherence, for some time past, to the modified Graefe extraction—a section throughout in the sclerocorneal juncture, a narrow conjunctival flap, and a small iridectomy made by a single snip with the scissors."

THOMAS R. BROWN, M. D. Cystitis Due to the Typhoid Bacillus Introduced by Catheter in a Patient not Having Typhoid Fever.—*Medical Record*, March 10, 1900.

ARTHUR W. ELTING, M. D. Intermittent, Gastric, Hypersecretion, with a Report of a Case.—*Boston Medical and Surgical Journal*, March 22, 1900.

HOWARD A. KELLY, M. D. What Precaution Shall We Take to Avoid Leaving Foreign Bodies in the Abdomen after Operations?—*New York Medical Journal*, March 24, 1900.

JOHN G. CLARK, M. D. A Critical Summary of Recent Literature on the Localization, Diagnosis, Prognosis, and Treatment of Gonorrhœa in Women.—*American Journal of the Medical Sciences*, January and April, 1900.

ANDREW H. WHITRIDGE, M. D. Bradycardia with Intermittent Albuminuria.—*Boston Medical and Surgical Journal*, March 29, 1900.

GEORGE BLUMER, M. D. Infectious Character of Tuberculosis and the Prognosis of Incipient Pulmonary Consumption.—*Albany Medical Annals*, April, 1900.

THOMAS MCCRAE, M. D. Spleno-Myelogenous Leukæmia with Disappearance of the Spleen Tumor and of the Myelocytes from the Blood.—*British Medical Journal*, March 31, 1900.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, March 5, 1900.

In the absence of the President, the meeting was called to order by Dr. Hurd.

The Inheritance of Deafness.—PROFESSOR W. K. BROOKS.

Some of you know, perhaps, that Professor A. Graham Bell, who is identified in the public mind with the invention of the telephone, has never regarded anything of so-called practical value, like the telephone, as his important scientific work. His life has been devoted to a subject that will appeal to us as more important, but which is not so regarded by the public. He has devoted his life to the amelioration of the condition of the deaf.

Many years ago, Professor Bell's attention was attracted to the fact that deaf people marry much more frequently in this country than they do abroad, the easy conditions of our life enabling them to do so to better advantage here than in foreign countries. These marriages are also increasing very rapidly, and he pointed out that this was accompanied by a very rapid increase in the number of deaf; they are increasing much more rapidly than the population at large. He attributed the tendency of deaf people to marry deaf people to our methods of teaching the deaf. We bring together in the community all the deaf children, as well as the hearing ones, and keep them there during the period when acquaintanceships are formed and they naturally learn a sign-language which separates them from the rest of the community. Believing, then, that this tendency of deaf people to marry deaf people might be due to our method of education, he has advocated teaching the deaf children regular speech in the common schools so that they will not be cut off by language or sympathetic fellowship from their associates, and he has thus made a good many bitter enemies among those whose business is the vested industry of teaching the old sign-language. He has been very successful in his efforts, and this method of teaching has been growing successfully, so that while more deaf children are still taught by the old method than by the new one, the latter is steadily gaining ground. Undoubtedly this will to some extent tend to do away with this tendency of deaf people to marry deaf people.

Professor Bell has endowed the Volta Bureau for the Amelioration of the Condition of the Deaf, an institution with a good equipment, and Professor Fay, one of the prominent educators of the deaf, has made use of it for gathering statistics

concerning the marriages of deaf people, and he has just published a volume of data which contains more statistical information than has ever been published on this subject before.

One interesting result of his study is to show that the influences that cause deaf people to marry deaf people are much deeper seated than Professor Bell supposed. These new statistics show that of the pupils of the asylums who marry, some two-thirds marry deaf persons. Of the deaf persons taught regular speech by the new method who have married, two thirds have married deaf persons. Of the deaf persons who have been to no institution and who have married, two-thirds have married deaf persons. The classes from which these statistics were taken were not of the same size, it is true, but they indicate that there is some psychological influence at work aside from that referred to by Dr. Bell. This report, however, accomplishes another purpose so successfully that it enables us to control the inheritance of deafness by giving deaf persons who contemplate marriage advice that is scientific, and Professor Fay can now advise them how to marry without the danger of transmission of deafness.

The book contains some 600 or 700 pages of statistics and percentages, and some three months ago I had them well in mind, but my mind is very leaky for figures, and I find the percentages are nearly all gone. I cannot, I fear, present them properly now and you must take such figures as I give with a grain of salt, though they will be, I think, substantially accurate. To show how much need there is for care in handling statistics, I may be allowed to tell an anecdote. I published, a little while ago, a review of this very book, and said that it contained a record of 5000 deaf persons who had married. I received a letter from the author saying I was wrong—that the book contained a record of 5000 marriages of deaf persons in which 8000 deaf persons were concerned.

This study, then, of 8000 deaf persons who have married, shows, in the first place, that deaf people are very much more likely to have deaf children than are hearing people, although they are much more likely to have hearing children than deaf children. Taking deaf people on the average, those who marry must expect to have one deaf child if they have eleven children, so that there are ten chances of a hearing child to one of a deaf child, while normally hearing people need not expect one deaf child in ten thousand children. Of course, this one may be the first or it may be the last of the ten thousand children, and the deaf child may be an only child, while the 9999 may be in other families. The liability to deaf children is not equally great with all deaf persons, the character of the

parental deafness having a great deal to do with it. Some deaf persons who have married deaf persons having large families with no deaf children, while all the children in others were deaf children.

Deaf persons are popularly divided into the congenitally deaf and the adventitiously deaf, the first never having shown any evidence of hearing, the second class having heard, but having lost the ability to hear. Now, when classified in this way there is a probability of transmission in, I think, 30 per cent for the congenital group, and less than 5 per cent for the second group. If it were possible to draw this line with rigorous exactness, if it admitted of any scientific restriction, it would always be highly imprudent for the congenitally deaf to marry, while much less hazardous for the adventitious deaf to do so; but this line cannot be drawn with exactness. Deafness is never discovered until the child has reached the age when normal children begin to talk. Then, too, many people who lose their hearing through disease, after having once heard, have deaf relatives, which shows that they had a susceptibility to deafness, that it was not purely adventitious, and that possibly from the scientific side it might really have been a congenital deafness. As a matter of fact most persons reported as congenitally deaf can only be said to be supposed to be congenitally deaf, and *vice versa*. You cannot divide the two classes on that line.

It has been known for a long time that deaf persons frequently have relatives who have deaf children; and Professor Fay has divided these 5000 marriages into two groups, those concerning people known to have deaf relatives, and those not known to have had such. Here the result is remarkable indeed, for deaf persons who have deaf relatives will have nearly 40 per cent of deaf children, while deaf persons without deaf relatives, who marry, will have only 1.2 per cent of deaf children. In a country like this, where very few persons know all their relatives, and where it is possible that it may be very difficult to trace collateral branches thoroughly, perhaps some of these deaf people that are reported to have had no deaf relatives simply had no known deaf relatives, and Professor Fay has stated that in some of his cases this was found later to have been the case. He thinks that where they have no deaf relatives there is really little more danger of deaf children than happens to normal people; that is, deaf persons without deaf relatives may marry with as much safety as ordinary people. Even there we cannot be sure, for deaf persons may have no deaf relatives, because they are not yet born, and deaf persons may have unborn brothers or cousins who will be deaf. As deaf people do not marry, however, until mature, as a rule, that danger is very slight, and it is pretty safe to advise them that they may marry provided they do not marry a mate with deaf relatives. On the other hand, deaf persons with deaf relatives should be advised not to marry under any consideration.

It did not fall within the province of Professor Fay to consider, statistically, the hearing persons who have married; but he shows clearly that a hearing person with deaf relatives is just as likely to transmit deafness as is a deaf person; and it is a little more unsafe for a hearing person with deaf relatives to marry than for a deaf person without deaf relatives; so it really becomes a question of the deaf relatives that cause the

danger. Neither deaf persons nor hearing persons with deaf relatives should marry, and they certainly should not marry persons with deaf relatives.

One of the peculiar points brought out is a little difficult to state. It is that deaf persons who marry hearing persons are more likely to have deaf children than those who marry deaf persons. He says that if all the deaf persons in this list had married hearing persons, the number of deaf children would have been increased 50 per cent. That fact had been suspected for a good while, and Darwin refers to it in his *Variations of Animals and Plants Under Domestication*, and says that it is very puzzling and cannot be explained at present. An English writer says that intermarriage of the deaf carries the inheritance to such a point of perfection that it topples over of its own weight. That is perhaps only a paraphrase of what Darwin says.

Now, if you look through the whole list of these 10,000 names—for there were 5,000 marriages, though only 8,000 deaf people—you find that many more deaf persons have married hearing persons with deaf relatives than have married deaf persons with deaf relatives. Deaf persons who marry hearing persons, then, tend to marry hearing persons with deaf relatives, and it is no more than you should expect, that the deaf persons who have married hearing persons should have more deaf children than the deaf persons who have married deaf persons; it is the deaf relatives, remember, that are the index of danger, This result which so puzzled Darwin has received a clear explanation.

One other matter I should like to speak of in this connection. Some twelve years ago I was asked to prepare a discussion on the conditions necessary to produce a deaf variety of the human race. The paper was presented to the Royal Commission for Investigating the Condition of the Deaf in England and was published along with a number of others. I asserted that the only condition necessary was that persons with deaf relatives should marry and continue to marry generation after generation, and that is exactly the result that Professor Fay has arrived at. I was in a hopeless minority at that time. All the other scientific men who prepared papers on this subject holding that all that was necessary was that deaf persons should marry deaf persons for successive generations. Professor Fay's study shows that they were wrong, and my conclusion, reached some twelve years ago, turns out to be exactly what this very great volume of statistics proves, and leads to Professor Fay's advice. Deaf persons who are sure they have no deaf relatives, may marry other deaf persons without deaf relatives, or may marry hearing persons without deaf relatives with impunity; but those who have deaf relatives, whether hearing or deaf themselves, should be discouraged from marrying either deaf or hearing persons who have deaf relatives.

The cases in which the transmission of deafness is greatest and where it rises above 50 per cent is where the parties having deaf relatives, marry these relatives; that is, when the marriages are consanguineous marriages between persons with deaf relatives. The intermarriage of people with deaf relatives is almost sure to result in deaf children, more than half of the children being deaf whether the marriage is between deaf or hearing people.

The Exhibition of a Three-months Infant with a Caudal Appendage.—DR. WATSON.

This infant has a peculiarity which I think is of sufficient rarity to be of interest to the Society. It has a tail. Its parents are not proud of it and want it amputated this week, so I exhibit the child to-night without having had time to look up the literature of the subject further than to ascertain that the condition is quite rare, although not unique.

It is a healthy male child a little over three months old. The tail springs from where a tail should, just posterior to the anus, and consists of two segments, a longer, thicker, more fleshy proximal segment, and a distal segment which is shorter, thinner and more fibrous. It is covered with normal skin. The length of the tail, when the child was three weeks old, was one and three quarters inches. Forty days later it was two inches and now it is two and a quarter inches long, having grown one half of an inch inside of three months;—apparently out of proportion to the growth of the rest of the body. It seems to have no connection with the coccyx, although it springs from the skin right over its tip. There seems to be no bony or cartilaginous tissue in it. It is well supplied with muscular tissue, and, in fact, the infant seems to express its emotions with the tail, for when the child is crying the tail shrinks up one half an inch in length, the distal portion partially telescoping within the proximal one. At other times it lies relaxed at full length or curls out upon the buttocks.

Dr. Harrison and I have secured some excellent photographs of the appendage. When it is amputated, Dr. Harrison will study it anatomically and we will make a further report.

DISCUSSION.

PROFESSOR BROOKS.—The South American Indians say that the white men wear clothes to cover up their tails. It is the custom to call abnormalities of this kind reversions, but it seems to me very doubtful whether you can regard them as anything like harking back to an ancestral type. Man, like all mammals, has a well-developed caudal region in the embryo, and its persistence is, I should think, simply a retardation of development. Normally, the tail stops growing at a very early stage; and, becoming very small and insignificant, forms the rudimentary coccyx. If that does not take place, there is a retention of the normal embryonic condition.

In this particular case you would have to go very far back to prove that there was harking back. The anthropoidal apes have no more tail than man, and you would have to go back considerably beyond the primitive condition of these apes to find anything like a tail. It does not look possible that that could be the explanation when we have at hand such a simple explanation as the one I have given. You do not suppose that a hairlip is a throwing back to the condition of rodents; it is simply a persistence of embryonic conditions.

Specimens of Cystic Kidneys.—DR. MACCALLUM.

Dr. Osler asked me to show one or two specimens from the museum. Cystic kidneys fall into two groups as he has mentioned, one like those passed around and one that occurs congenitally. The appearances as you see are rather different. The cysts as seen in childhood usually contain clear contents

and are of a different color. In connection with this, too, one usually finds some other changes. Here is the child from whom these kidneys were taken. There was a condition of hydrocephaly, and there were seven or eight fingers or toes on each hand or foot. The kidneys may be large enough to cause obstruction to birth, and in this case they had to be removed before the child could be delivered.

There are two theories as to their origin—the inflammatory, as described by Virchow, who thought the cyst-formation really the result of retention due to marked interstitial nephritis about the pillar of the kidney, and the non-inflammatory theory advocated by those who consider the cyst due to constriction of the tubules higher up as the result of chronic troubles; other authors think that the mere weakness of the walls of the tubules allows of the retention.

The French authors usually adopt the neoplastic theory, believing that it is simply due to proliferation of tissue bringing about the cystic growth. They describe them as adenocystoma.

Shattuck ascribes the formation of the cyst to the malposition of portions of the Wolffian body in the kidney, but some work recently done tends, I think, to rather disprove that. Rindfleisch ascribes it to failure of union of the cortical tubules with those of the medulla.

In connection with the cystic kidneys found in adults, as Dr. Osler stated, we sometimes find cysts in the liver, and here is a specimen which illustrates it. This is the kidney from a case seen by Dr. Thayer, which came to autopsy some time ago, and is almost exactly like the one passing around, but the liver in that case showed numerous small cysts.

Monday, March 19, 1900.

The meeting was called to order by the President, Dr. Thomas.

Idiopathic Dilatation of the Colon.—DR. FUTCHER.

This case is one of considerable interest. Usually rare cases come in pairs. Some time ago we had in the Hospital a case of dilated colon, which is now followed by this child with the following history: He is four years of age, and was born in Massachusetts. There was nothing especially remarkable about the child in the first few months. He seemed to be mentally a bright child for his age. At one year of age it was noticed that the abdomen was very large and its appearance soon became the talk of the neighbors. In 1898, he was taken to the Holyoke Hospital, where he remained under observation for a considerable time. Previous to that the child had been very constipated, going for six or seven days without a movement, and then such periods would be followed by severe attacks of diarrhoea. The movements were usually of a drab or whitish color. When constipated the child was especially dull, but at other times did not suffer and seemed quite bright mentally. Fortunately for the little fellow he was well taken care of by a nurse who became interested in the case, and up to the present time he has been carefully attended to, and has not been suffering. He has been getting irrigations twice a day.

The boy has a markedly distended abdomen, but not so

much now as when he came to us a week ago. There was then a very striking distention of the upper part of the abdomen, particularly above the level of the umbilicus. The abdomen is fairly symmetrical, and you see the child is well-nourished, and intelligent-looking. If you look at the child from the side you will see how pendulous the abdomen is, and how the distention is greater above the level of the umbilicus than it is below. No definite peristalsis can be made out even by stimulating with a cold towel. While under treatment during the last week he has been getting daily irrigations, and with each a fairly large constipated stool was passed. He seems quite comfortable except that the irrigations occasionally cause some irregular contractions, and at such times he complains of pain. The abdomen is now a little softer than on admission, and no fecal concretions can be made out by palpation, but that is not an indication that none are present, because the same condition was noticed in our other case, which was eventually found to have a large amount of fecal concretion in the colon.

The case is one of so-called idiopathic dilatation of the colon. There are three or four different types of colon dilatation. In the first class may be placed those cases in which there is simple gaseous distention. In the second group come those cases in which there is distention of the colon from contents of some form, either fecal, or foreign bodies introduced from without and more rarely by gall-stones. In the third group are those cases which result from organic obstruction in front of the distended bowel. Then there is the fourth group of so-called idiopathic dilatation of which this is the type.

Some believe that in these so-called idiopathic cases there is some actual constriction or stricture of the bowel in the region of the sigmoid flexure. Treves, I believe, holds this view and believes that it is always present. The colon becomes very markedly hypertrophied, that is, the muscular tissue of the wall is very much increased in thickness, but in the majority of cases no change has been observed in the mucosa.

One of the most remarkable cases is that reported by Formad in the University Medical Magazine, Vol. 4. It was a case of a dilated colon in a man 23 years of age. He was known as the "balloon man," which was an appropriate name as shown by the illustrations which I show you. The colon in this case was of enormous size, being as large as that of the ox, and when removed, weighed 47 pounds.

As to treatment there is not very much that can be done, and the cases generally terminate fatally early in life. If kept under careful observation, they may live with comfort for a considerable number of years. Surgical interference is advisable in some cases. Treves had a case in which he excised the greater part of the colon with a successful result. The operative procedure usually performed for relief of the symptoms is that for an artificial anus.

I will pass around photographs of the colored boy whom we had in the wards recently. In his case there was pronounced peristalsis which is usually a marked feature. This boy had an enormous abdomen. Passing up over the left half of the abdomen, crossing its upper part and occupying the right

hypochondrium was an enormously distended portion of the bowel which we believed was the sigmoid flexure, and which proved at operation to be such. This patient had the condition since he was eight years of age, and was fourteen years old when operated upon. He, too, gave the history of alternate constipation and diarrhœa. When he entered the hospital he had not had a movement for fourteen days. He was operated upon, the sigmoid flexure being excised, but unfortunately peritonitis set in and the boy died. The colon was enormously dilated, measuring 49 cm. at its greatest circumference. It contained large quantities of semifluid feces. At autopsy the colon contained about eight quarts of semisolid feces.

The advisability of a colotomy in this case is being considered.

Report of Gynecological Cases.—DR. MILLER.

CASE 1.—*Acute gonorrhœal peritonitis.* The patient was a young woman married just two months whose husband gave a history of having been treated in the dispensary here for two years for gonorrhœa. He had been pronounced cured by a competent assistant after repeated examinations of the slight discharge that still existed. Two months after marriage, at the menstrual period, the patient developed severe pain in the pelvis and the discharge was more profuse than usual. The pain occurred especially on the right side. In a few days the abdomen became distended and she had nausea, vomiting, elevation of temperature, and in fact all the signs of general peritonitis. She was sent into the hospital and operated upon by Dr. Kelly.

The entire picture and operation was that of peritonitis and the infection had evidently come through the tubes both of which contained pus which was discharging into the abdominal cavity. Both tubes were removed and she made an uninterrupted recovery. Although coverslips were negative and cultures on ordinary agar proved negative, I think it was a gonorrhœal infection. The infection came through the tubes, and to a woman who has never been pregnant there are practically only two kinds of infection through the tubes; first, gonorrhœal, and second, tubercular. I believe if we had had the proper media we should have grown the gonococci.

CASE 2.—*Ovarian abscess with general peritonitis.* In this case there was general peritonitis with pockets of pus in either flank, and free pus in the peritoneal cavity. She recovered after washing out the peritoneal cavity and removing the uterus and both tubes. She had always been healthy, but her periods had been irregular and painful. She had three miscarriages, the first two giving no trouble, but the third was the beginning of the present illness. Tenderness was excessive in both groins. No swelling had been noticed, but when she came in we found a lump in the lower part of the abdomen. Examination showed a pelvic mass on left side about the size of a large orange and intimately connected with the uterus. At operation the peritoneal cavity contained pus and there was a fibrinous deposit on all the intestines. There was a large abscess of the tube and ovary of the left side, which contained a yellowish brown offensive pus. The right ovary was cystic and adherent. Enucleation was done in the usual manner, but the patient's condition became so bad on the table that the pus

was imperfectly removed from the peritoneal cavity and a drain had to be placed in the pelvis. The pulse was so rapid and weak that she had to be infused repeatedly for the first night, but after that her recovery was satisfactory. The offensive odor of the pus led me to believe it was a colon-bacillus infection, but coverslips and cultures were both negative.

CASE 3.—*Suppurative Ovarian Cyst with Formation of Gas inside the Cyst.* The patient was a woman forty-three years of age, who had been admitted ten years previously on the medical side, but having refused operation for the removal of the cyst was discharged. She had severe pains at times, but kept her health pretty well until the last four months. When she came in she looked septic and was very weak. The elevation of temperature was not very marked. A tumor mass could be made out extending down into the pelvis and up into the abdominal cavity. It was tympanitic over nearly the whole of its surface. This complicated the diagnosis very much. At operation the tumor was found to be an ovarian cyst densely adherent to the abdominal wall and intestines and having a very thick wall. Incision was made into the cyst and there was an immediate escape of gas and a very offensive brownish necrotic material containing some pus. Coverslips showed a bacillus that was thought to be too small for the gas bacillus, and cultures were negative. Five days after the operation cultures were again made and showed the colon bacillus, but probably that was not the nature of the original infection. She has improved greatly in general health, and the whole interior of the cyst-wall is gradually sloughing away.

NOTES ON NEW BOOKS.

Thirtieth Annual Report of the Massachusetts State Board of Health. (Boston: Wright & Potter Printing Co., 1899.)

This report contains about nine hundred pages of matter describing the work done under the direction of the Board for the year ending September 30, 1898.

The general contents and arrangement of the report are similar to those with which the many who appreciate the work of this Board have been familiar in past years.

It is a commendable characteristic of New England that the membership of efficient government boards is left unchanged from year to year in recognition of their services. The death of Dr. Charles P. Worcester, Chief Analyst in the Food and Drug Department, after ten years' service must be chronicled with regret.

The year 1898, in Massachusetts, was characterized by the greatest freedom from epidemics with one or two exceptions in the last half-century.

The typhoid death-rate has been reduced from 8.2 in 1871-75 to 2.5 during 1898. In this connection it may be noted that the work of Mark W. Richardson, in confirming for Massachusetts the observations of earlier investigators elsewhere, has called renewed attention to the transmission of typhoid fever through the urine of otherwise recovered typhoid patients. Richardson found typhoid bacilli in the urine in such cases in about 25 per cent of those examined, the bacilli persisting sometimes for considerable periods. The fresh urine may be even cloudy with organisms. It is a simple matter to "plate out," and to test the colonies thus isolated with typhoid serum or blood. This is worth the consideration of health officials in districts where typhoid is prevalent and water supplies are not well guarded indicating a possible method of cultural release from isolation on the same general principles as the release of diphtheria cases.

In diphtheria, the fatality for the pre-antitoxin, four-year period (1891-1894), was 28.3 per cent of cases; for the antitoxin period (1895-1898) 15.6 per cent.

In consumption it is gratifying to note a steady decrease. The classification of this disease, now universally regarded as distinctly infectious, under the "zymotics" is justly criticized, but is nevertheless retained in Massachusetts. Still this classification is not quite so bad as the retention of "alcoholism" under the same heading—a classification which seems crude if not absolutely barbarous—and only recently abolished. A State hospital for consumptives has been established. As illustrating the progress of sanitation in this disease, it is not out of place to note that Boston has now (1900) joined the list of cities in which the reporting of pulmonary tuberculosis is compulsory and in which disinfection is performed by the Board of Health after the death or removal of the tubercular patient. Combined with the supervision of tuberculosis in schools, these advances should contribute powerfully to the further reduction of cases in the future.

An outbreak of dysentery was investigated by O. Richardson, with the result that an organism regarded as *B. coli com.*, but unusually virulent, was isolated and considered as the pathogenic organism.

Under Filtration of Sewage, a good account of experimental work on the "septic tank" method for purification is given. While acknowledging that the present firm establishment of an unfortunate nomenclature in the literature of this subject makes it now somewhat difficult for isolated writers to introduce more appropriate terms, we think that the State Board of Health of Massachusetts carries sufficient weight in the scientific and sanitary world to make it well worth while for that Board to suggest a new phraseology. For instance, "septic" tank as a name for the receptacle in which bacterial decomposition of the sewage takes place might better be changed to "decomposition" tank. We feel particularly disposed to criticize the use of the term "toxin" in the statement made on page 442 to the effect that the formation of toxins in sewage is illustrated by the formation of gas under certain circumstances. Certain products of bacterial activities are classed as ptomaines. Only such ptomaines as are capable of producing toxic effects on animals are designated as toxins. It may be that the products of the bacterial decomposition of sewage are toxic to animals, but the experiment described certainly fails to illustrate or demonstrate such toxicity.

Mr. H. W. Clark contributes a paper describing a large number of experiments on the action of various waters on lead pipe, designed to determine the relation between the substances originally in solution in the water and the degree of action on the lead. It was shown that in general the active agents are oxygen and carbon dioxid, and that the purer the water, the greater the action. In waters showing high hardness, the action of the oxygen and carbon dioxid was reduced. Waters high in organic matter may not attack lead until the organic matter is decomposed and carbon dioxid thus set free. Iron, galvanized iron, zinc and block tin were also experimented with.

The engineers of the Board contribute a paper reviewing the working of the sewage filtration plants at present in operation in the State.

Under Food and Drug Inspection, the comforting assurance is given that the staples are almost never adulterated, and that the adulteration, when it is found, is rather commercially fraudulent than physiologically harmful. For instance, one hundred and forty-five samples of wheat flour tested yielded adulteration in only five instances, consisting only of a small percentage of corn flour. The cost of this inspection was about \$11,000 for the year. As the daily ration of the State is estimated to cost \$625,000 and for the year therefore \$228,125,000, it will be seen that the very valuable supervision of the supply costs but .005 per cent of the value of the material supervised. The articles most liable to adulteration are

milk, butter, spices, coffee, syrups, molasses, cream of tartar, honey, vinegar, jellies, jams, olive oil and certain kinds of canned goods. Preparations of foods for diabetic patients, advertised as starch-free or nearly so, showed in the majority of cases a larger percentage of starch than the limit claimed and sometimes as much as is present in ordinary wheat flour.

The report of the bacteriological laboratory is restricted to an account of the antitoxin results for the year and of the diagnostic work on diphtheria, tuberculosis and malaria. By an oversight in proof-reading, the tables (pp. 738-740) giving the results of the diphtheria cultural examinations have been made to show the doubtful results as reaching about one-third of the total cultures. The figures given under the heads of "Doubtful Cultures," and "Cultures Examined for Release from Quarantine," should be transposed, thus making the doubtful results only about 1 per cent.

Dr. S. W. Abbott contributes an exhaustive Life Table for Massachusetts.

The Series of Annual Reports from this Board are of such a uniformly high order that one can find but little to criticize. Compared with similar reports from other sources, these stand almost or quite at the head. Compared amongst themselves, however, we detect in the last two or three years a distinct dropping off in the contributions on original investigation which made former reports so valuable to others than statisticians, as well as to the latter. We should be glad to have a detailed account of the making of the various antitoxins carried out with such success by Dr. Theobald Smith. We think that a bacteriological investigation of the waters of the State, so thoroughly worked over on the chemical and "biological" sides, would furnish much information. With the improved technique, and the clearer conception of bacteriology developed of late years, a great deal of the disheartening confusion which exists in the present records of water bacteriology might be cleared up by a prolonged systematic and carefully worked out examination of the species to be found.

In ridding the State of typhoid-polluted water a great advance has been made, but doubtless there still remain some minor sanitary questions in the same line. The epidemic of dysentery already referred to suggests one of these.

In conclusion, we may again congratulate the Board upon this continued evidence of the excellence of their work.

HIBBERT WINSLOW HILL.

The Anatomy of the Brain. A Text-book for medical students.

By RICHARD H. WHITEHEAD, M. D., Professor of Anatomy in the University of North Carolina. Illustrated with forty-one engravings. (*The F. A. Davis Co.*, 1900, pp. 1-96.)

Dr. Whitehead has done a real service to the medical students of America in preparing this volume. The surface anatomy of the various parts of the brain is first described, the classification of tissues and the nomenclature of the Basel Commission being adhered to. This is followed by a description of the internal anatomy of the same parts, the text being everywhere illustrated by somewhat schematic but accurate drawings. A section on the various conducting paths in the brain terminates the volume. The language is everywhere clear and simple, and the descriptions are systematically arranged. The student will find in this volume the simplest and at the same time the most accurate and concise introduction to the study of the anatomy of the brain in English.

BOOKS RECEIVED.

System of Medicine. By many writers. Edited by Thomas Clifford Allbutt, M. A., M. D., LL. D., D. SC., F. R. C. P., F. R. S., F. L. S., F. S. A. Volume IX. Mental Diseases and Diseases of the Skin. 1900. 8vo. XII+998 pages. The MacMillan Company, New York. MacMillan & Co., Ltd., London.

The Journal of Experimental Medicine. Edited by William H. Welch, M. D. Volume IV. With thirty plates and seventeen figures in the text. 1899. 8vo. XII+654 pages. D. Appleton and Company, New York.

The Johns Hopkins Hospital Bulletin. Volume X. 1899. 4to. 240 pages. The Johns Hopkins Press, Baltimore.

Refraction and How to Refract, including sections on Optics, Retinoscopy, the Fitting of Spectacles and Eye-glasses, etc. Two hundred illustrations, thirteen of which are colored. 1900. 8vo. XII+301 pages. P. Blakiston's Son & Co., Philadelphia.

Transactions of the Washington Obstetrical and Gynecological Society. Volume V. October 4, 1895 to June 16, 1899. 8vo. 456 pages.

The International Text-Book of Surgery. By American and British Authors. Edited by J. Collins Warren, M. D., LL. D., and A. Pearce Gould, M. S., F. R. C. S. Volume I. General and Operative Surgery, 947 pages. Volume II. Regional Surgery, 1072 pages. 1900. 8vo. W. B. Saunders, Philadelphia.

Surgical Pathology and Therapeutics. By John Collins Warren, M. D., LL. D. Second edition, with an appendix. Illustrated. 1900. 8vo. 873 pages. W. B. Saunders, Philadelphia.

Saint Thomas' Hospital Reports. New series. Edited by Dr. Hector Mackenzie and Mr. G. H. Makins. Volume XXVII. 1899. 8vo. 483 and 120 pages. J. & A. Churchill, London.

Catalogue of the Anatomical and Pathological Preparations of Dr. William Hunter, in the Hunterian Museum, University of Glasgow. Catalogue prepared by John H. Teacher, M. A., M. B., C. M. Two volumes. 1900. 8vo. LXXVII+943 pages. James MacLehose & Sons, Glasgow.

A Pocket Medical Dictionary giving the Pronunciation and Definition of the Principal Words used in Medicine and the Collateral Sciences, etc. By George M. Gould, A. M., M. D. Fourth edition, revised and enlarged, 30,000 words. 1900. 16mo. 837 pages. P. Blakiston's Son & Co., Philadelphia.

Twentieth Century Practice. An International Encyclopedia of Modern Medical Science by Leading Authorities of Europe and America. Edited by Thomas L. Stedman, M. D. In twenty volumes. Volume XIX. Malaria and Micro-organisms. 1900. 8vo. William Wood and Company, New York.

Elements of Clinical Bacteriology. For physicians and students. By Dr. Ernst Levy and Dr. Felix Klemperer. Second enlarged and revised edition. Authorized translation by Augustus A. Eshner, M. D. 1900. 8vo. 441 pages. W. B. Saunders, Philadelphia.

Report relating to the Registration of Births, Marriages and Deaths in the Province of Ontario for the year ending 31st December, 1898. Printed by order of the Legislative Assembly of Ontario. 1900. 8vo. 50+CCXXII pages. Warwick Bros. & Rutter, Toronto.

Essentials of Surgery. Together with a full description of the Handkerchief and Roller Bandage. Prepared especially for students of medicine. (Saunders' Question Compend, No. 2.) By Edward Martin, A. M., M. D. Seventh edition, revised and enlarged. With an Appendix. Illustrated. 1900. 12mo. 342 pages. W. B. Saunders, Philadelphia.

An Essay on the Nature and the Consequences of Anomalies of Refraction. By F. C. Donders, M. D. Revised and edited by Charles A. Oliver, A. M., M. D. (Univ. Pa.). 1899. 8vo. VIII+81 pages. P. Blakiston's Son & Co., Philadelphia.

Diseases of the Nose and Throat. By J. Price-Brown, M. B., L. R. C. P. E. Illustrated with 159 engravings, including 6 full-page color-plates and 9 color-cuts in the text, many of them original. 1900. 8vo. XX+471 pages. The F. A. Davis Company, Philadelphia, New York, Chicago.

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BULLETIN

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NOTES ON THE PLAGUE IN CHINA AND INDIA.*

By JOSEPH MARSHALL FLINT, *The Johns Hopkins University.*

side from the recent outbreaks of Bubonic Plague which attracted such widespread interest in themselves, there something in the historical associations of the disease that lent to them an added interest. Probably no other medical subject has been so extensively used for literary material as the Pest, for the dramatic and harrowing episodes of the epidemics have afforded ideal material for descriptive writers who have availed themselves of its riches again and again. Thus Boccaccio, Defoe, Gibbon, Hodge, and others† have described the havoc it played in Europe when it was known as the Black Death. Accordingly, when, with the Philippine Commission, in Hong-Kong and later in India we had the opportunity of seeing the disease, it was evident that the aspects of its epidemiology and environment were quite as interesting and certainly more dramatic than the clinical and pathological features of the disease itself.

The last recorded epidemic of note was that which occurred in Egypt in about 1825, and from that time to the outbreak in

Hong-Kong, the disease has been endemic in the central portion of China. Not much attention was paid to it, however, until Hopper‡ noted its existence in Yunnan. He says: "Despite of such a favorable climate, Méng-tzü, in common with other parts of Yunnan, has suffered annually for a period of years from the plague, a kind of malignant fever, fatal in a few days, having as one of its symptoms a hard swelling in the neck, in the armpits, or in the groin, which has carried off a number of its inhabitants. On approach of the epidemic, the first victims are rats, which, fearless of human beings rush madly into their presence, and after capering around the room fall dead at their feet." From Yunnan the disease traveled to Pakhoi by one of the common trade routes, where according to Lowry and Horder, it has been endemic for over twenty years. In 1891, it broke out in Kao-chao, later in towns situated on the West River, and finally in 1894, a severe outbreak occurred lower down in Canton. Now, the infection of Hong-Kong proceeded either from Pakhoi or Canton; but inasmuch as Pakhoi is more than three times as far from Hong-Kong as Canton, and the Hong-Kong commerce with the latter port is hundreds of times greater than that with the former, it is probable that Canton was the source of contagion. Supporting this view is the following significant fact: On the second of March, 1894, a large Chinese procession was held in Hong-Kong, which was attended by over 40,000 Cantonese coolies of the lower class.

I wish to express my indebtedness to Prof. Simon Flexner and Prof. L. F. Barker for permission to report these notes on the trip which were made while the Philippine Commission was on its trip.

Boccaccio: The Decameron. Introduction. Defoe: The Journal of the Plague Year. Defoe: Due Preparation for the Plague. Vincent: Loimologia. Vincent: God's Terrible Voice in the City. Vincent: Loimographia. Pepys: Diary. June 7th, 1665, to Jan. 1666.

‡ Imperial Maritime Customs, Annual Report, 1889.

At this period, tens of thousands were dying of the plague in Canton, and accordingly it is not improbable that the Island of Hong-Kong was inoculated then.

The first cases appeared in the district of Tai-ping-shan where the sanitary conditions are worse than in any other part of the city. (Properly speaking the city is called Victoria and the island Hong-Kong, but the latter name is now commonly used for the city as well.) In the native and European quarters of the city, Hong-Kong presents a strange contrast, for the European districts, from a sanitary point of view, are probably unexcelled in any city in the Orient; but the native quarter, notwithstanding some fairly broad, clean streets and new buildings, is really a whitened sepulchre. Here, in the tenements and side alleys, the coolies live in indescribable filth; the segregation and overcrowding being so great that at night the overflow sleeps in the streets. Many of these in the native districts are so narrow that one walking with outstretched arms can almost touch the buildings on opposite sides of the road. The houses are three or four stories high and originally contained fairly large-sized rooms. The Chinaman, however, with his naturally frugal mind, subdivides them by cheap wooden partitions, and makes four rooms for one. With the decrease in the size of the rooms goes an increase in the number of their occupants, so that in one poorly ventilated tenement from 30 to 40 natives are huddled together, with less than 150 cubic feet of air-space per capita. As yet the coolie has not learned even the rudiments of personal hygiene, and the Chinese enjoy the unenviable distinction of being one of the filthiest peoples on the face of the earth. Apropos of this trait, some one has fitly called them practical Malthusians. One day in Hong-Kong we counted 14 coolies pulling and pushing a meat-cart that could have been drawn easily by a single horse; so, in a country where man and the horse show in a commercial ratio of 14 to 1, little in the way of civilization or personal æsthetics can be expected. As a rule the common

Lowson* says: "At the beginning of the outbreak a majority of the houses were in filthy condition. When to a mixture of dust, old rags, ashes, broken crockery, moist surface soil, etc., is added faecal matter, and the decomposing urine of animals and human beings, a terribly unsanitary condition of affairs prevails; and that this is no overdrawn picture of what was to be met with in Tai-ping-shan, many Europeans now know to their cost." One must recall, moreover, that Hong-Kong is Europeanized China, and that the conditions prevailing there do not compare with those found in Canton, for example—a typical Chinese city like those in other parts of the celestial Empire. Indeed, in comparing it with Canton, there is something almost Utopic about the sanitary condition of the native quarters of Hong-Kong.

Once begun, the epidemic was fought by the following general sanitary measures: (1) Removal of the sick and dead. (2) Temporary segregation of those exposed while the premises were being disinfected. (3) Cleansing and disinfecting of "infected premises." (4) Disinfection of clothing. (5)

General cleansing and limewashing of all tenement houses. (6) House-to-house visitation. (7) Disinfection of public latrines. These measures were all carried out with a considerable degree of success—much more success than attended similar ones established later in India. This is due partly to the fact that the Chinaman is more easily bullied by superior power than the Hindu, and partly because the customs offered by the plague regulations are, in China, for the most part more personal and are neither national nor religious.

During the height of the epidemic the medical staff had more to do than it could accomplish, but by the aid of a number of British soldiers, especially assigned to plague duty, managed to keep up the routine work necessitated by the sanitary plague regulations. In this work the greatest opposition came from the unwillingness of the Chinese to send patients to the hospitals and the resistance they made to house-to-house inspection. In the secretion of cases, moreover, they went to unheard-of extremes, and the district inspectors in their search for patients often saw sights that it seems almost impossible to believe. Dr. Lowson says, for example: "I overpaint the pitiable surroundings associated with plague work at the commencement of the epidemic would be impossible. I have entered a long, low cellar, without any window opening, and with air entering only by a square opening from the level of the roof three or four stories high. Down one side of the shaft ran a broken earthenware drain-pipe leaking freely, the contents streaming down the wall of the air-shaft to a shallow pool of filth which crossed the undrained floor of earth. Although it was broad daylight outside, a lantern was necessary to see one's way. On a miserable matting, soaked with abominations, there were four coolies stretched out. One was dead, the tongue black and protruding. The next had the muscular twitchings and a semi-comatose condition heralding dissolution. In searching for bubo we found a huge mass of glands extending from the groin part's ligament to the knee-joint. This patient was beyond the stage of wild delirium. Sordes covered the teeth and were visible between the blackened and parted lips. Another sufferer, a female child about 10 years old, lay in the accumulated filth of apparently two or three days, unable to speak owing to the presence of enlarged cervical glands. The fourth was wildly delirious and was constantly vomiting. The attendant—the grandmother of the child—had a temperature of 103°F and could only crawl from one end of the cellar to the other. She was wet through and was herself doomed. This is not a fancy sketch but a true picture of how we found some of our patients at the outbreak of the scourge in Hong-Kong. So one unfamiliar with the horrors of the coolie accommodation in China, could credit how the poor live in Hong-Kong, or could imagine how the horrors of their everyday life were intensified by the plague." In disinfecting some infected premises one day Dr. Lowson told us that in one room the inspectors were forced to dig through two feet of dirt and human excrement to reach the floor.

The mortality from plague in Hong-Kong among the Chinese varies between 91 and 93 per cent, so that almost all of those afflicted, no matter what their treatment, died. Naturally, in view of these facts it is not astonishing that

*Lowson: J. The Epidemic of Bubonic Plague in 1894. Medical Report, Hong-Kong, 1895.

coolies rebel against sending their sick into the hospitals, for here the tremendous mortality is emphasized much more than would be in cases that remained at home. Both in the Tung-Wah Hospital and Kennedytown Hospital for infectious diseases, wards are set aside where those who elect may receive private treatment. Of course, this practically amounts to a recognition of the quackery of the Chinese doctors on the part of the government, which thus officially assumes the responsibility for their treatment. This practice is now being strenuously opposed by the Colonial medical men.

During our visit to Hong-Kong, the plague was quiescent and there were only from 16 to 20 deaths a day from the disease. The house to house visitation at this time had been broken up, so that the majority of these cases were found dead in the streets and were carried by the inspectors to the mortuary. On entering the morgue each morning the sight was a ghastly one, for the bodies were lying about on the



JAMES A. LAWSON, CHIEF PLAGUE OFFICER AT HONG-KONG, IN FRONT OF THE KENNEDYTOWN HOSPITAL.

coolies waiting until the hasty autopsies, necessary for burial, could be performed. Many that had not been discovered promptly were fly-blown, while other cadavers that had for several days been lying undiscovered in obscure places were eaten by maggots before they were carried to the mortuary. The disposal of cases that die after successfully eluding the vigilance of the district inspectors is facilitated by the habit which coolies have of sleeping on the streets during warm nights. In Hong-Kong, during the hot season, night shows many weird and picturesque sights. The little narrow streets in the native quarters, lighted dimly by the flickering street-lamps are completely covered by the sleeping coolies who are drawn from the crowded and poorly ventilated houses by the stifling heat. They are so crowded that one cannot walk for any distance without stumbling over the half-naked sleepers who lie stretched on little pieces of matting. So when a secreted plague patient dies, he is carried out by relatives and laid in the

street among the sleeping forms. Most of these rise at dawn to go to work, and those that do not are usually taken later to the mortuary by the plague inspectors.

The mortuary is situated half-way up the hill on the outskirts of the city toward Canton, and consists of a modern deadhouse, an office for the government medical officer, and quarters for the native care-taker. The first striking thing about the plague bodies was the presence on many of two parallel rows of deep purple spots about the size of a Spanish dollar extending from the sides of the neck down on to the chest. At first sight these appeared to be a new manifestation of the disease until Dr. Lawson told us that these purpuric spots were the result of the Chinese method of counter-irritation. This consists in firmly pinching the skin between the thumb and forefinger until it is bruised. As there is, in plague, a general tendency to hemorrhagic extravasation into the skin and serous membranes, the blood oozing from the torn vessels into these traumatic areas soon turns black, and gives the appearance which we first noted. Mosquito and flea bites behave in much the same manner. Likewise the slightest scratch or



SMALLPOX WARD AT THE KENNEDYTOWN HOSPITAL.

bruising of the skin is apparently always followed by a pink blush, and later by a subcutaneous hemorrhage which soon changes to a dark purple-colored spot. In many cases we observed extensive bullæ filled with blood-stained serum, and in one or two instances the idiopathic hypodermic hemorrhages which gave the disease its mediæval name of the Black Death.

The main plague hospital in Hong-Kong is now at the old Kennedytown Barracks, in the extreme outskirts of the city, which have been converted into a hospital for infectious diseases. Here principally plague and smallpox cases are received. The hospital occupies a commanding position at the foot of Mount Austin, from the base of which the grounds extend to the water's edge. The main building, a substantial stone structure overlooking the mouth of the West River towards Kowloon, is covered by stucco, and contains the laboratory, offices and a few wards. The major part of the hospital, however, consists of rude matsheds made of palm-thatched walls and roof stretched over bamboo frames. They have rough board floors, and are lined by coarse matting. On the whole they make a fairly hygienic hospital, except that thorough disinfection of the wards is impossible. A few

supported on piles over the water's edge are perhaps more sanitary than the rest, because they get air and sunlight in greater abundance. As a rule these wards are large enough for four or five patients, their small size being a decided advantage, as convalescents and those in the early stages of the disease are thus kept from witnessing the depressing scenes



A ROW OF PLAGUE WARDS IN THE KENNEDYTOWN HOSPITAL.

that often occur when patients are in the delirious stages of the malady. Plague patients do not have beds or cots but lie on a platform made of boards, supported by ordinary carpenter's horses, over which is spread a small oblong piece of matting. They have no bedding, and their heads rest on the peculiar Chinese pillows which look more like bamboo rat-traps than



MATSHEDS AT THE KENNEDYTOWN HOSPITAL, WHERE NATIVE TREATMENT IS GIVEN.

anything else. When patients get in the maniacal delirium that often accompanies the acute stage of the disease, they are tied down on their rough litters by cloth thongs. A patient so controlled can be seen in the accompanying photograph. In the male wards there are coolie attendants while the women

are nursed by amahs. Besides the Kennedytown Hospital there were during the days when the epidemic was at its height several other temporary hospitals established in the city, and a floating hulk, the *Hygeia*, nicely fitted up and anchored near the Kennedytown Hospital, was used for European and Japanese patients. Aoyama, the Japanese physician who was infected from an autopsy wound, was treated on this ship.

Epidemics begin in the bubonic form, and when the epidemic is at its height and the mortality is greatest, changes to pneumonic plague, and finally in the defervescence stage dies off again in the bubonic type. This has occurred regularly in Hong Kong, and has been noted in the many epidemics that have occurred in India by the plague authorities there. Atmospheric conditions do not seem to have much influence on the disease, except that during the rains, people are driven into the crowded, dirty houses, where they are more exposed to infection; and the bacilli, moreover, are protected under these circumstances from the dessicating and bactericidal action of the sun's rays. This, Kitasato has shown, is one of the most potent agents in the destruction of the plague bacilli.



PLAGUE PATIENT UNDER RESTRAINT IN THE HONG-KONG PLAGUE HOSPITAL.

exposure for an hour usually being quite sufficient in temperate climates to destroy the germ. Epidemics are usually heralded by a great mortality among the rats, which seem, when affected with plague, to lose all fear of human beings and run about the houses. In part, at least, the infection of the rats can be accounted for by the ingestion of septic material, sputum and dejecta of plague patients, but by far the most prolific cause of its spread is by fleas. It is well known that fleas soon leave the bodies of rats dead of the plague, and it is supposed get on to other healthy uninfected rats. The agency of these insects as transporters of the disease has been shown by Simond* and by Lowson who put fleas from plague rats on healthy rodents, and found that they died of the disease about three days. Flies and mosquitoes, however, do not seem to play such an important rôle in the transmission of plague to human beings, for both infest the wooded area about the Kennedytown Hospital, and yet no one of the attendants there

*Simond: "Propagation de la peste" *Annales de l'Institut Pasteur*, Oct., 1898.

as ever infected. By far the most important atria of infection in human beings are through abrasions of the skin, through the mucous membranes of the respiratory tract, and to a lesser degree through the alimentary tract. Plague, like any infectious disease, thrives where sanitary conditions are poor; and in China and India finds naturally ideal conditions for its spread among the hordes of natives whose lives of misery and squalor form the dark side of the human picture in the Far East. The symptoms and bacteriology of the pest have already been well described in the translations of the papers of Kitasato and Aoyama which appeared in this journal some years ago* so reference will be made only to some of the more important points which were brought to our attention in India and China. It appears that the disease may exist in any of its forms alone, two or even more may simultaneously complicate each other in the same patient. In the simple bubonic type the location of the bubo indicates that the portal of entry of the infection occurred in the area drained by that set of lymph-glands, but it is also not uncommon to find glands enlarged *en échelon*. Thus, in one of our Hong-Kong autopsies the femoral, inguinal, axillary and lumbar groups were all enlarged and hemorrhagic. From the observations made at the Arthur Roads Hospital in Bombay, based upon the study of a large number of cases, the results of the buboes occurred as follows:

Femoral,	32.12	per cent.
Femoro-inguinal,	23.36	" "
Axillary,	16.35	" "
Inguinal,	12.38	" "
Cervical,	5.25	" "
Multiple,	4.67	" "
Total	94.13	" "

The frequency with which the buboes occur in the lower sets of lymph-glands is explained by the fact that both in India and China, natives of the lower classes go barefoot. But in connection it is worthy of note that all of the men in the Hampshire segment in Hong-Kong who were attacked with the plague while on inspection duty had femoral or inguinal buboes, even though they were well-booted. Their trousers, however, were open at the bottom, admitting dust particles laden with plague bacilli. While on similar duty in India, the soldiers always wore puttees, and not a single case was reported among them.

In most cases the buboes are exquisitely tender and generally require local applications to relieve the pain. For this purpose the ice-bag has been used with good effect in India. Between the portal of entry and the enlarged glands, there is often a well-marked lymphangitis and at different points multiple lymphatic abscesses may occur. This was particularly marked in Aoyama's case. When we met him in Japan, he showed us the scars of the numerous incisions made to relieve the condition about which there was a slight tendency to the formation of keloid. This has been repeatedly observed in

Hong-Kong among the Chinese who have recovered after a complication of suppurating buboes or lymphatic abscesses. Most of the buboes do not suppurate, but the fact that the great majority of cases die within two or three days after the onset undoubtedly bears a relation on this point. Likewise, it seems that mixed infections have a very important influence on the question of suppuration as the following figures show. In the pus of 29 suppurating buboes examined by the several continental commissions working in Bombay, the following results were obtained:

Bacillus pestis,	8
Staphylococci,	9
Streptococci,	5
Sterile,	7
Total,	29

A suppurating plague bubo forms a most indolent ulcer and the granulations at the base sprout with such reluctance that it may take months for them to heal. Fortunately in these old chronic ulcerations the pus is usually sterile. In one case in Hong-Kong, followed by recovery, the femoral vessels lay exposed in the base of a large slough about a suppurating bubo.

The incubation period in plague varies between three and nine days, but in the majority of cases averages about five or six. It seems that there are no constant prodromata, and the onset, as a rule, is sudden, marked by headache, fever, backache, and a general feeling of malaise. Vomiting of a blood-stained fluid has been observed not infrequently at the onset, a phenomenon due to the action of the plague toxin in the mucous membrane of the stomach which, at autopsy, is nearly always injected and ecchymotic. In Hong-Kong, they were in the habit of speaking of the plague facies, which Lowson believes is often of assistance in the diagnosis of the disease. It consists of a mixture of anxiety, cyanosis, and dyspnoea, and in mentioning it Lowson says: "Generally speaking, there is something indescribable in the face of the plague-stricken which seems to help your diagnosis—an expression as if the sufferer himself knew all about it, and his inner consciousness had left its mark upon his features." There is something quite characteristic about the plague tongue, which has a heavier coating than in typhoid fever and is considerably clearer about the margins. Soon the coating turns black and sordes often cover the teeth and lips. After the onset the fever usually rises rapidly and reaches its maximum in from 12 to 24 hours. The common temperature ranges from 103° to 105° F., but cases with a fever as high as 108° are not infrequently observed.

The patient soon after the onset shows evidence of great prostration. The pulse, at first, is full and bounding, and later becomes feeble and collapsed. Dirotism is very common, and the heart, in the majority of cases, needs repeated stimulation to overcome the cyanosis. The cardiac symptoms observed clinically in plague cases conform in general to the results obtained experimentally by the injection of the toxic nucleoprotein of the Pest bacillus into animals. Lustig and Galeotti have also shown† that the subcutaneous injection of

* Flexner: Bulletin of The Johns Hopkins Hospital, Vol. VII, No. 1, 1896.

† Bulletin of The Johns Hopkins Hospital, Vol. V, Oct., 1894.

† Lustig and Galeotti: Lo Sperimentale, 1898.

large amounts of the plague toxin into animals is followed by a local thrombosis at the point of inoculation, and that the blood-pressure in dogs falls rapidly to 10-15 mm. of mercury, accompanied by a progressive diminution in the force and rhythm of the heart-beats soon resulting in death.

On the second or third day, the cerebral symptoms usually appear: these consist of a general apathetic condition on the part of the patient, coma or delirium of varying degrees. During this period it is often difficult to get the patients to take nourishment, and the attendants must resort to strategy or rectal feeding. This was notably the case with Doctor Aoyama, who could only be tricked into taking nourishing draughts by appealing to his politeness, on the one hand, and his patriotism on the other, by alternately toasting Queen Victoria and the Mikado in champagne, milk and other nourishing and stimulating beverages. During this period of the



ONE OF THE PLAGUE STREETS, POONA.

disease symptoms of meningeal involvement and cerebral hemorrhages were sometimes observed.

The respiratory symptoms in most cases consisted of a marked hypostasis owing to the marked cardiac weakness; but when the pneumonic type of plague was present, the condition was more often of a lobular type. In uncomplicated cases the plague bacillus can be found in the sputum, but oftentimes there is present a mixed infection with the pneumococcus. Edema of the glottis and extensive laryngitis were also found in some of the Bombay cases. During the course of the disease, as well as at the onset, vomiting occurs and the vomitus in such cases is stained with both bile and blood. The spleen is palpable and remains so during the course of the disease. There is always some albumin in the urine, but it is small in amount; likewise casts, epithelial debris, and occasionally Plague bacilli are also found. In general the disease runs its course in five or

six days, but the fever may remain elevated for weeks especially in cases where there is a secondary pyæmic infection. Death in most cases occurs from heart failure. No cases of reinfection above suspicion have been reported, but relapses are not uncommon during convalescence and result usually from local extension from the original focus of the disease.

Between the plague in China and India there are many points of difference which depend, it seems, partly on the character of the natives. In China the pest is more fatal than it is in India, the death-rate among the Chinese being 93 per cent, and only about 82 per cent among the low-caste Hindus, who are the heaviest sufferers from the disease in India. The general standards of life and personal hygiene are much lower among the Chinese than they are among the Hindus; but for some reason the epidemics are so much greater in India that the terrible effects of the disease are more obvious and its many horrors are impressed on the observer by the magnitude of the sufferings of the natives. Since the first outbreak in India, in 1896, the death-rate has constantly increased each year, until, in 1899, more than 50,000 people died of plague in the City of Bombay alone. Moreover, the disease has now spread in



PLAGUE FUNERAL IN INDIA.

large part of India and has appeared in Bengal, Madras and many points in the Bombay Presidency. The really serious part of the question is that apparently it is still on the increase and precisely what the end will be no one at present can forecast. The Colonial Government, however, is doing all in its power to stamp out the disease, and no experiment is left untried that offers the slightest hope of solving this very serious question.

The plague measures in India are much like those in Hong Kong except that they are, perhaps, not quite so thorough. In India the plague authorities have had to fight against the bigotry, opposition and animosity of the native who gives far more trouble to the sanitary authorities than his celestial neighbor. Here exist the ideal conditions for the spread of a disease; namely, overpopulation, overcrowding, malnutrition, unhealthy environment and crude and unclean methods of living. Under these conditions the energy required to fight the plague in India has been tremendous because of the inertia of the vast population, which even looked with disfavor on the measures meant for its good. In Bombay alone, the plag-

expenses for the first year of the epidemic amounted to over fifteen lakhs of rupees.

Certain facts concerning the plague epidemics of India have been more fully described in another place;* but the methods of treatment employed in India and the results obtained in their use are of the greatest importance. No effort or expense has been spared by the Indian government to try any method that offers any hope of relieving the distressing conditions. To this end, the Bombay Presidency has fitted up the old government house at Parel as a plague laboratory, and here the plague prophylactic of Haffkine and Lustig's *Heilserum* are manufactured. Yersin, it appears, was the first to manufacture a serum supposed to act as an antitoxin to the poisons produced by the plague bacillus. Like the diphtheria antitoxin it was made on the assumption that the plague toxins were soluble products of the growth of the pest bacillus and could be obtained from filtered fluid cultures of the organism. The first cases treated by the antitoxin were in China and the results, it is stated, were very satisfactory. Somewhat later



WARD IN POONA PLAGUE HOSPITAL. THE PATIENT COVERED WITH A BLANKET IS DEAD.

several plague patients at the Arthur Roads Hospital in Bombay were inoculated with the antitoxin, but the results were practically negative; so, from lack of both results and material, further experiments with Yersin's serum were not undertaken. In the Oporto epidemic Calmette† used Yersin's serum and reports excellent results with it. Two facts, however, should be noted, *i. e.*, that the number of cases treated in India was too small to allow any conclusions as to the real value of the antitoxin as a therapeutic agent to be drawn, and, on the other hand, that the cases occurring in Portugal were by no means as severe or fatal as those among the natives of Bombay.

Then some time later Haffkine,‡ making experiments along

* Barker and Flint. "A Visit to the Plague Districts of India." New York Medical Journal, Feb., 1900.

† Calmette: Presse Médicale, 1899.

‡ Report on the Outbreak of Bubonic Plague, 1896-97. Bombay, 1897.

the same line reported to the health commissioner that his efforts to obtain an antitoxin for plague by methods similar to those used by Behring, Kitasato and Roux for diphtheria were unsuccessful and that his experiments resulted negatively. At a later period Lustig and Galeotti§ had a similar experience, but they found, however, that the essential toxin was situated in the body of the plague organism and was of the nature of a "*nucleoprotein toxique*." They succeeded in isolating this toxin by the following method: A three days' growth of the plague bacillus on large agar plates is scraped off and dissolved in 1 per cent KOH. This solution is filtered and acidulated with dilute acetic acid, whereupon it yields an abundant white precipitate which is washed and dried and in this state can be kept indefinitely. It is prepared for use by dissolving in a dilute solution of sodium bicarbonate [0.5 per cent]. This *nucleoprotein toxique*|| is soluble in alkalis and insoluble in dilute acids. In general it gives the proteid reactions and by artificial digestion can be split up into peptone and an insoluble nuclein. When injected experimentally it produces the symp-



LOW-CASTE HINDU DEAD, POONA MORTUARY.

toms which we have already described. It is from this *nucleoprotein toxique* that the antitoxin is manufactured by injecting it into a horse. The quantity used naturally depends a good deal on the condition and strength of the animal. The injection is followed by a violent reaction at the site of inoculation; an area of localized oedema half as large as a man's head may persist at the point of inoculation for many days. We saw that condition in one of the horses at the Parel Laboratory in Bombay. These large injections are repeated as often as the condition of the horse permits until the required degree of immunity is produced. Then the serum is withdrawn and prepared in the usual way. As yet the number of antitoxic units has not been determined by animal titration, and the preparation of the serum in large quantities has only just begun. The complete reported results thus far include 175 inoculations, with 100 deaths, and 75 recoveries, or a mortality of 57.30 per

§ Lustig and Galeotti: Lo Sperimentale, 1898.

|| Galeotti: Arch. des Sciences Biologiques. Tome VIII, 1899.

cent. Thus, the mortality for plague averages about 73.70, so that, at present, the serum saves about 16 per cent of the cases. In these inoculations the cases were not selected but were taken as they came, and included 18 in which dissolution was imminent. After the injection a hypothermic action was noted which seems in plague cases to be a specific reaction, as it was never obtained when people who were not suffering with plague were inoculated. At times considerable prostration seemed to follow the injection and a slight increase in the cardiac weakness so that caffeine, camphor or ether were often given with the antitoxin. After the second injection there was an amelioration of the conditions. The antitoxin, according to Galeotti, acts in a manner exactly opposite to the *nucleoprotein toxique*. The pulse becomes less frequent and the diastolic disappears; there is an augmentation in the force of the heartbeat, while the buboes, at the same time, become less painful, and any tendency to suppuration is arrested. Bacilli, moreover, tend to disappear from the blood. In pneumonic cases and in the severer gastro-intestinal infections, the antitoxin in its present strength apparently has no effect.



CHILD DEAD OF PLAGUE, POONA MORTUARY. PREPARATION FOR FUNERAL.

Soon after the outbreak of plague in India M. Haffkine, formerly of the Pasteur Institute, who had been at work in India on some problems concerning cholera, began the preparation of a prophylactic against plague.* The principle involved in the preparation of that fluid is similar to that followed by Lustig somewhat later in the manufacture of his *Heilserum*; namely, that the plague toxin resides in the body of the pest bacillus, and cannot be obtained from the soluble products of its growth. The preparation of the Haffkine prophylactic fluid is now carried on, on a large scale, in Bombay; and it is shipped all over India and to many other parts of the world. At present the prophylactic meets with great opposition from the natives, especially the Hindus, who will not submit to inoculation because the fluid contains meat, and thus offends one of their most cherished religious principles. To meet this

* Haffkine: The plague prophylactic. *Ind. Med. Gazette*, June 1897.

— Remarks on the plague prophylactic fluid. *Brit. Med. Jour.*, 1897, Vol. II.

objection an effort is being made to procure a medium on which to grow the organisms from a substratum gluten and other substances free from meat extracts.

The manufacture of the prophylactic is quite simple, and through the kindness of Dr. Melne, who had charge of the Parel Laboratory in Haffkine's absence, we were able to follow the prophylactic through the various stages of its preparation. A kilogram of finely chopped goat's flesh, after macerating in hydrochloric acid, is placed in an autoclave and heated for six hours under a pressure of three atmospheres. This is then filtered and neutralized with KOH and diluted up to three litres when it becomes the medium in which the plague bacillus is grown. Some plague material is put into these flasks and the bacillus is identified by what Haffkine has described as the stalactitic growth. If such cultures rest absolutely undisturbed for five or six days, after being inoculated on the surface, fine delicate thread-like processes can be seen hanging from the surface into the depths of the bouillon which have a very strong resemblance to the stalactites that hang from the



MOHAMMEDAN GIRL BEING BURIED BY THE HOSPITAL AUTHORITIES.

roof of a grotto. This growth, according to Haffkine, is pathognomonic of the plague bacillus, and the purity of such culture can be tested microscopically. The culture is put into a Pasteur flask, from which a large series of 3-litre flasks are inoculated after it is certain that the original culture is uncontaminated. These are grown in a large, darkened room containing long tables on which hundreds of these 3-litre flasks rest. Owing to the high mean temperature thermostats are unnecessary in India. To make the prophylactic it is necessary to get repeated crops of the stalactites in each flask and to keep the surface inoculated; a small amount of sterilized "ghee," a sort of clarified butter, which floats on the surface and always contains after the original inoculation a few bacilli, is added so that after repeated shakings the surface of the culture is always reinoculated. In this way five or six crops of stalactites are obtained before the serum is finished, and this takes, as a rule, about six weeks. After agitating the flasks, the little clumps of bacilli sink slowly to the bottom and a new surface growth slowly appears. The culture is killed by immersion in a constant water-bath at

0° C. for three hours when some carbolic acid or thymol is added, and while care is taken to keep it well shaken the prophylactic is decanted into small bottles and is then ready for use. The usual dose of the plague prophylactic was about 2 cm., but at Hubli, where it was used most extensively, Leumann* was in the habit of using a greater quantity at each injection. He always took into consideration, however, the age and physical condition of the patient in making the inoculations. An ordinary antitoxin syringe is used for this purpose and the injection made well into the subcutaneous tissue. Injections into the skin are apparently more painful than those made well below the corium. After two inoculations with the plague prophylactic the blood of the patient usually gave the Widal reaction. This, however, is not obtained so readily after a single protective injection. Leumann allows from 14 to 20 days to elapse between the first and second injections, and regards the constitutional reaction of headache, fever and malaise as more important than the agglutination test. Extremes of age do not seem to affect the value of the inoc-



BURNING GHÂT, POONA PLAGUE HOSPITAL.

ulation, as on one occasion a child 10 days old was inoculated while on another, a woman of 90 was protected against the disease. Women as far advanced in pregnancy as the seventh month were inoculated without the occurrence of any unfavorable symptoms, a fact which is rather interesting when one considers that all pregnant women taking the disease themselves abort. To avoid, as far as possible, the injection of the protein in the incubation stage of the disease, it was regarded as a safe rule not to inoculate any one with a temperature of 100° F. until it was certain that he was not suffering from the plague.

Since it has now been generally recognized that, under the conditions which obtain in India, the hygienic and sanitary measures have little or no effect in influencing the course of the epidemic or lessening the mortality from the disease, the results obtained at Hubli have been most successful and gratifying. In all some 78,000 inoculations were done in a period of four months in Hubli, in the province of Dhárwâr, many of

which were, however, on the inhabitants of the outlying districts and villages. It seems that the double inoculations have a greater protective power against the disease than single injections of the prophylactic, which statistically is shown to amount to 10 per cent of the total mortality among the inoculated. But in Dhárwâr the results were even better than at Hubli; for there were, among 4,926 single inoculations, 45 cases and 15 deaths; and in 3,387 double inoculations, 2 cases and 1 death.

Moreover, among these inoculations were undoubtedly included some cases where the prophylactic was given to those in the incubation period of the disease. Hubli, where the Haffkine serum received its first large and comprehensive test, is a mercantile town of about 50,000 inhabitants. It was attacked by the pest at the beginning of the monsoon rains, and the average monthly rainfall between October and April reached 28 inches. Although a large health camp was established, and as many plague regulations as possible were put in force, it was evident that the authorities could not cope with the epidemic, so they determined to make a thorough test of the prophylactic. Mr. Cappell, the collector of Dhárwâr, says: "If this experiment had failed, the mortality, judged by the actual mortality among the uninoculated, would have been appalling. All possible sanitary measures in the shape of disinfection, unroofing of houses, and segregation were applied concurrently with the inoculation as the government is already aware; but the rate of mortality among those who held back from inoculation rose at one time to a height which, I believe has never been approached elsewhere—standing in the third week of September at the figure of 657 per thousand per week."

The duration of the protection afforded by the serum could not be definitely determined, although the majority of the citizens were protected for at least 5 months. In 69 households, all of the inoculated members escaped the disease while some of the uninoculated in the families succumbed to the disease. Perhaps a more conclusive idea of the scope of the enormous experiment may be gathered from the appended table, which shows that at only one period did the non-inoculated have a percentage advantage over the inoculated in the mortality tables and that was when the epidemic was not severe and the number of the inoculated was low.

DATES.	Number of non-inoculated in Hubli.	Number of twice inoculated in Hubli.	DEATHS FROM PLAGUE AMONGST		PERCENTAGES IN FAVOR OF	
			Non-inoculated.	Twice inoculated.	Non-inoculated.	Twice inoculated.
Five weeks { From 11th May, 1898, to 14th June, 1898, }	44,573	531	47	1	41 %	.....
Week ending						
21st June, 1898.....	41,494	2,220	22	1	..	18 %
28th June, 1898.....	39,042	3,956	29	Nil.	..	100 "
5th July, 1898.....	36,020	5,160	55	3	..	61 "
12th July, 1898.....	33,255	7,289	34	2	..	72 "
19th July, 1898.....	29,716	8,959	82	6	..	75 "
26th July, 1898.....	24,112	10,311	100	9	..	80 "
2nd August, 1898.....	21,031	12,660	140	9	..	85 "
9th August, 1898.....	15,584	15,845	272	11	..	95 "
16th August, 1898.....	10,685	19,191	386	31	..	96 "
23rd August, 1898.....	6,367	23,362	371	20	..	over 98 "
30th August, 1898.....	4,091	26,547	328	20	..	96 "
6th September, 1898.....	2,731	28,671	227	23	..	over 99 "
13th September, 1898.....	1,116	30,911	143	39	..	" 99 "
20th September, 1898.....	973	31,683	106	24	..	" 99 "
27th September, 1898.....	603	31,872	58	16	..	" 99 "

* Report No. 7569, of 1898.

A STUDY OF CHRISTIAN SCIENCE.

By HARRY T. MARSHALL, M. D., *Fellow in Pathology, The Johns Hopkins University.*

As it is useful and interesting in the field of medicine to examine into the conditions and causes of diseases, not only for the object of curing them, but in order to understand the reasons for their existence; so, in the same way is it profitable to examine those products of civilization which may well be considered diseased, not treating them as things of no interest, but as curious pathological products, whose origin and condition it is worth while to investigate, and whose causes are of interest because they show, to a certain extent, the workings of the human mind.

Particularly must we remember, that, however irrational and absurd the condition may be, it is still the result of definite, actual forces, which can be studied and treated reasonably, in just the same way that the problems presented by a fever or an inflammation can be handled.

This evening we will consider one of the pathological conditions affecting society—a condition not unlike insanity, but a condition that affects a very large part of the community, that appears to have a strong foothold, which is powerful from the number, character and wealth of those affected by it, and which is a menace to the health and safety of the community.

In my paper this evening I will consider various features of Christian Science.

Christian Science originated in 1866, the "discoverer" being Mrs. Mary Moss Baker Glover Patterson Eddy. For upwards of ten years she developed the system, gradually gaining adherents among her acquaintances and finally in 1875 she published her book, "Science and Health with Key to the Scriptures." This marks the official beginning of the "Science." Since that time, largely owing to the energy and zeal of Mrs. Eddy, the number of her followers has been increasing with great rapidity and her "discovery" has been spread over one-half the world. At the present day the rate of increase is very high, and Christian Science is constantly being disseminated in fresh quarters. The following figures may give some idea of the present strength of the movement:

The rate of increase is said to be 40 per cent per annum, with a monthly addition of 5 to 7 churches. In December, 1899, the "Christian Science Journal" gave a list of all the Christian Science churches numbering at that time about 370, distributed among 350 odd cities. In addition, there were about 100 less completely organized congregations, over 100 Christian Science reading-rooms, and 30 odd Institutes or Academies where Christian Science is taught. There are two magazines, and many publications at irregular intervals. The churches are found in nearly every State in the Union, in Canada, England, France, Germany, Australia, Hawaii and other places. Boston and Chicago, however, are the two greatest Christian Science strongholds. The Mecca of Christian Scientists is the church in Boston, erected in 1894, at a cost of over \$200,000. The expense was defrayed by subscription, and it is said that so liberal were the contributions that about \$50,000 had to be returned.

It is claimed that 1,000,000 people have received Christian

Science treatment, that the number of professed followers is 400,000 to 500,000 in the United States, and that there are as many more who are influenced by Christian Science but do not openly adopt the faith. Carol Norton claims 2,000,000 followers for Mrs. Eddy. In Maryland there are 500 actual members enrolled, and from 1000 to 1500 people who occasionally employ the Christian Science healers.

A noteworthy fact is that the ignorant and uneducated classes furnish but a small proportion of Christian Scientists, while the vast majority of them are people who have had good educations and who might reasonably be expected to think; people, moreover, who constantly come into contact with others of discrimination and at times with those of intellectual ability. Furthermore, Christian Scientists, with few exceptions, are drawn from those who can add at least a moderate amount to the wealth of the church.

Except for a very limited number of converts among the inhabitants of our jails, I have never heard of Christian Science being carried to the poor. Other observers have commented upon this fact.

The only life of Mrs. Eddy that I can find was apparently written by a Christian Scientist. She is of an old New England family and is now, according to common report, about 80 years of age and in feeble health. She is of a strongly religious temperament, and from childhood has been fond of such subjects as metaphysics, moral science, philosophy and logic. She has always been positive in her own opinions, and at 12 years would not yield her views concerning some religious tenets when she was admitted to the Congregational Church.

She was married in 1843 to Col. George Washington Glover of South Carolina, who died a year later, leaving her with one child. Her second husband was named Patterson. From him she was divorced, dropped his name, and Christian Scientists never mention him. He was her husband at the time of the "discovery" of Christian Science. Her third husband was Dr. Asa Eddy, who died in 1882.

She is said to have written extensively in prose and verse, under a nom de plume; in addition, she has written copiously about Christian Science and has composed some hymns. Her most important Christian Science writings are: "Science and Health with Key to the Scriptures," and "Miscellaneous Writings."

Mrs. Eddy was at one time a homoeopathic practitioner; she is an ardent advocate of woman's rights, has remarkable energy and zeal, and not only has the most implicit faith in herself and her mission, but inspires her disciples with the same faith.

As is natural in the case of a person so much before the public, there are unpleasant rumors as to her early life.

Common report has it that Mrs. Eddy was very poor before she "discovered" Christian Science. At present she has a palatial home in Boston; another at Concord; she has given munificently to her son, and is said to donate \$80,000 per annum to charities.

The origin of Christian Science is described as follows:

Mrs. Eddy was always a student of the Bible, but never could understand why God's healing and consoling gospel could give her no help in her sicknesses and feeble health, even though she was always religious. The answer came in 1866 at Lynn. "In company with her husband, she was returning from an errand of mercy, when she fell upon the ice, and was married helpless to her home. The skilled physicians declared that there was absolutely no hope for her, and pronounced the verdict that she had but three days to live. Finding no hope and no help on earth, she lifted her heart to God. On the third day, calling for her Bible, she asked the family to leave the room. Her Bible opened to the healing of the palsied man (Matt. ix, 2). The Truth which set him free, she saw: the power which gave him strength, she felt: the Life Divine which healed the sick of the palsy, restored her, and she rose from the bed of pain, healed and free. When she walked into the midst of the family, they cried out in alarm, thinking that he had died and that they beheld her ghost: this miraculous restoration dates the birth of Christian Science."

From the foregoing outline it is evident that Christian Science is something more than an empty fad; nor can we dismiss it as humbug. We must take it for what it is—a strong and growing movement, commanding the energy, enthusiasm and financial backing of a large and influential contingent of our fellow beings and working for ends that are contrary to our ideas of progress and enlightenment. What, then, is Christian Science? What are its ideals and ideas? What rôle does it propose to fill in the play of human life? and what is its *raison d'être*?

The following account of Christian Science is based upon Mrs. Eddy's text-book—which her disciples hold equally as sacred as the Bible, upon lectures by Carol Norton and others, and upon information very kindly furnished me by Mr. Hermann Hering, Christian Scientist of this city.

Mr. Hering has very courteously devoted considerable time explaining to me various Christian Science doctrines, and has furnished me with all the data respecting the organization, religious customs, the Christian Science college, &c.

As its fundamental object, the text-book advances new ideas concerning the nature and origin of sin, of sickness and of death, and purposes to abolish them entirely.

The ideas concerning sin, sickness and death are corollaries of the conclusions as to the ultimate nature of God, of the human intellect and of matter.

The central thoughts of Christian Science are contained in the following quotation from the text book (p. 7):

"The fundamental propositions of Christian Science are summarized in the four following, to me, *self-evident* propositions. Even if read backward, these propositions will be found to agree in statement and proof.

1. God is all in all.
2. God is good. Good is Mind.
3. God, Spirit, being all, nothing is matter.
4. Life, God, omnipotent Good, deny death, evil, sin, disease. Disease, sin, evil, death, deny Good, omnipotent God, Life."

To put it less epigrammatically: God is not merely the

Creator and Controller of the Universe. He is the Universe. Every portion of the Universe is a portion of God. God is not a personal God. To make Him personal, they say, would be to make him finite. He is conceived of as Spirit; universal Spirit, or Divine Mind.

The most difficult task in Christian Science is to obtain a clear conception of the human intellect or soul. The following quotation may serve to give the Christian Scientists' meaning of the term.

It may be prefaced that intellect, thought, will, sensation &c., are collected under the term "mortal mind"—a term frequently appearing throughout the book with various significations. To quote (pp. 9-10):

"SCIENTIFIC DEFINITION OF MORTAL MIND.

First Degree: Depravity.

Physical: Passions and appetites, fear, depraved will, pride, envy, deceit, hatred, revenge, sin, disease, death.

Second Degree: Evil disappearing.

Moral: Honesty, affection, compassion, hope, faith, meekness, temperance.

Third Degree: Spiritual salvation.

Spiritual: Faith, wisdom, power, purity, understanding, health, love.

In this third degree mortal mind disappears."

To put it in another way. There are two forces acting upon man. Primarily man is a part of God, is controlled by God, and all that he does is right and a part of divine harmony. But in some way—how, it is not clear—a second force begins to act. This force is defined as "*mortal mind*." This mortal mind, though endowed with powers to be stated below, has no real existence, but is only a false impression. At times this force is obedient to the Divine Mind controlling man, and acts in unison with it, but at other times, mortal mind becomes antagonistic to Divine Mind. When mortal mind is not in accord with Divine Mind, various departures from divine harmony result. These departures are not products of Divine Mind, but creations of mortal mind, and it is these creations of mortal mind that make up every ill that man is heir to. These ills are summarized as sin, sickness and death. But mortal mind does more. It is responsible for every departure from perfection that is to be found in the animal and vegetable kingdom, not only at the present day, but through all the ages. Mrs. Eddy's definition of mortal mind is (p. 583):

"Mortal Mind. Nothing, claiming to be something, for Mind is immortal; mythology; error creating other errors; a suppositional material sense, alias the belief that sensation is in matter, which is sensationless; a belief that life, substance and intelligence are in and of matter; the opposite of Spirit, and therefore the opposite of Good, or God; the belief that life has a beginning, and therefore an end; the belief that man is the offspring of mortals; the belief that there can be more than one creator; idolatry; the subjective states of error; material senses; that which neither exists in Science, nor can be recognized by the spiritual sense; sin; sickness; death."

This brings us to the Christian Science conception of matter.

Not only is mortal mind the direct cause of every evil as above described—it has further activity. The conception of God as Spirit, and of God as actually constituting the universe, necessitates the further conception that the universe is spirit; in other words, that there is no such entity as matter, and it is said that “Matter is a subjective state of mortal mind evolved in belief by false material sense” (p. 2).

The formal definition of matter is (p. 582):

“Matter. Mythology; mortality; another name for mortal mind; illusion; intelligence, substance and life in non-intelligence and mortality; life resulting in death, and death in life; sensation in the sensationless; mind originating in matter; the opposite of Truth; the opposite of Spirit; the opposite of God; that of which immortal Mind takes no cognizance; that which mortal mind sees, feels, hears, tastes, and smells only in belief.”

Carol Norton, a member of the International Board of Lectureship of the Mother Church of Christian Science in Boston, Mass., says that matter is but an externalization of the human mind, and can be governed by *Mind*.

Now, starting with the conceptions that the universe is God the Spirit, and that everything else is evil and the result of the action of mortal mind, how is Christian Science to pass from the clouds of speculation to the field of practical life?

The step is simple.

No matter what may be the manifestation of mortal mind, it can always be rendered negative by creating a firm belief in the reality of Divine Mind, and at the same time just as firm a disbelief in the existence of mortal mind and its products.

The firmer these beliefs, the more completely can the manifestations of mortal mind be overcome.

What is the method by which this is accomplished?

A believer, or Christian Science Healer, sits beside the afflicted one and, as it is said, *argues* the false impression away, replacing it by the true belief. The argument, consists not in reasoning, but in the positive, confident and oft-repeated declaration of the non-existence of the disease and of the totality of Divine Mind.

This is continued as long as it is considered necessary and in addition the healer, or both patient and healer, read from Mrs. Eddy's book.

The following selections from the text-book describe the method of practice, and illustrate the Christian Scientist point of view:

(pp. 410-11) “Always begin your treatment by allaying the fear of patients. Silently reassure the patient as to his exemption from disease and danger. Watch the result of this simple rule of Christian Science, and you will find that it alleviates the symptoms of every disease. If you succeed in wholly removing the fear, your patient is healed. The great fact that God wisely governs all, never punishing aught but sin, is your standpoint, whence to advance and destroy the human fear of sickness. Plead the case in Science and for Truth, mentally and silently. You may vary the arguments, to meet the peculiar or general symptoms of the case you treat; but be thoroughly persuaded in your own mind, and you will finally be the winner.

You may call the disease by name when you mentally deny it; but by naming it audibly, you are liable to impress it upon the thought. . . . To prevent disease or to cure it mentally,

let Spirit destroy this dream of sense. . . . Argue with the patient (mentally, not audibly) that he has no disease, and conform the argument to the evidence. Mentally insist that health is the everlasting fact, and sickness the temporal falsity. . . . If the case is that of a young child or an infant, it needs to be met mainly through the parent's thought, silently or audibly, on the basis of Christian Science.”

(pp. 422-423) “If the case to be treated is consumption, take up the leading points included (according to belief) in this disease. Show that it is not inherited; that inflammation, tubercles, hemorrhage, and decomposition are beliefs, images of mortal thoughts, superimposed upon the body; that they are not the Truth of man; that they should be treated as error, and put out of thought. Then these ills will disappear. If the lungs are disappearing, this is but one of the beliefs of mortal mind. Mortal man will be less mortal, when he learns that lungs never sustained existence, and can never destroy God, Who is our life. When this is understood mankind will be more Godlike. What if the lungs are ulcerated? God is more to a man than his lungs; and the less we acknowledge matter or its laws, the more immortality we possess.”

(pp. 46-47) “You say a boil is painful; but that is impossible for matter without mind is not painful. The boil simply manifests your belief in pain, through inflammation and swelling and you call this belief a boil.”

(p. 48) “When the sick recover by the use of drugs, it is the law of a general belief, culminating in individual faith, which heals; and according to this faith will the effect be.”

(p. 51) “Mortal mind confers the only power a drug can ever possess.”

(p. 369) “A physical diagnosis of disease—since mortal mind must be its cause, if it exists—generally has a tendency to induce disease.”

(p. 411) “The daily ablutions of an infant are no more natural or necessary, than would be the process of taking a fish out of water every day, and covering it with dirt, in order to make it thrive more vigorously thereafter in its native element.”

(p. 67) “When there are fewer doctors, and less thought is given to sanitary subjects, there will be better constitutions and less disease.”

This may serve to give some idea of what Christian Science is. By applying these beliefs the Christian Scientist undertakes to turn the criminal to the path of righteousness, and give health and vigor to the weak and suffering, and eventually, to bring the world to a condition devoid of wickedness and disease, with a final triumph over death.

In a schematic way I have presented the essentials of Christian Science and it is evident that there are two main points of view from which it can be considered. 1. Christian Science as a religion, and a philosophy, including its application to every-day life. 2. Christian Science as a system of medicine.

1. CHRISTIAN SCIENCE AS A RELIGION.

Mrs. Eddy constantly claims that Christian Science is pure Christianity; that the teachings of our Lord were only half understood by the Disciples, and that the early Christians soon lost completely the true idea of Christianity, and that it was

only through her "discovery" in 1866 that the full and true meaning of Christ's Doctrine was given to the world.

It is needless to discuss how much of Christianity their religion does, in fact, contain. It is enough to note that they believe in the one Spirit, constituting and controlling the universe and all the forces and powers therein. Moreover, they believe in Mrs. Eddy as the modern prophetess, or interpreter to man of the meanings of God. Her authority is almost absolute. Every word that she says is accepted by the Church without question as an *ipse dixit* utterance. Her position is not unlike that of the Pope's during the Middle Ages.

She is referred to as the "Mother of the Church," or simply as "Mother." Her church in Boston is called the Mother Church.

In this magnificent church there are two windows. In one window is a figure of our Lord. In the other is a representation of the woman described in Revelation: "A woman clothed with the Sun and the Moon under her feet and upon her head a crown of twelve stars." This woman, Christian Scientists claim, is Mrs. Eddy, and her text-book is the book referred to in Revelation. At intervals around the walls of this church are quotations signed alternately, "Jesus Christ," and "Mary Eddy."

In the Christian Science Church there are no ordained ministers. The readers at any church are elected by the congregation, subject to the approval of the Board of Directors in Boston. There are no grades corresponding to bishops, deacons, etc. Mrs. Eddy's own pupils, however, are looked upon as of higher authority than others.

There is no baptism, no confirmation, no giving of the sacraments at communion, and no special marriage services. The communion is celebrated twice a year, and is purely a mental or spiritual receiving of the same. There are no marriages performed in Christian Science churches except by readers who were previously ministers in Christian churches, and, therefore, by their former ministry, authorized to perform the ceremony. This is done, as a Christian Science reader told me, "So that not every Tom, Dick or Harry could marry people."

In general the government of the churches is Congregational in its outlines, that is, they are independent of each other to a large extent. But each church is controlled by Mrs. Eddy and by a Board in Boston that exercises a general supervision over the church in business, religious and legal matters.

The readings in all Christian Science churches are identical on any given service, the selections being made by the Board in Boston.

There are two forms of service: the informal experience meetings and the regular services.

The latter consist in reading selections from the Bible and from Mrs. Eddy's book and in singing hymns. At a meeting at I attended there were two readers. No. 1 read a few verses from the Bible. No. 2 then read Mrs. Eddy's interpretation of it. No. 1 then read a few more verses from a different part of the Bible, to be followed by Mrs. Eddy's interpretation, and so on. The only departure from the above routine is when a circular letter is read from "Mother to her children."

In this religion there is no thinking, no reasoning, no room for the use of the natural energies of the mind; in other words, no room for advance.

Mrs. Eddy's interpretation of the Bible furnishes the most wonderful part of the whole subject of Christian Science, for it is wonderful that anybody can take it seriously for an instant.

I do not care to comment upon the gross ignorance displayed in her derivations and interpretations, upon her vapid mysticism, nor upon her childish fondness for alliteration and cheap plays upon words; but instead I will merely read a few selections from her book:

Mrs. Eddy devotes a chapter to explaining scriptural words in terms of Christian Science; prefacing the chapter with the remark that "It contains the metaphysical interpretation of Bible terms—giving their spiritual sense, which is also their original meaning" (p. 570).

The following are a few of Mrs. Eddy's definitions:

"*Benjamin* (Jacob's son): A physical belief as to life, substance, and mind; human knowledge, or so-called mortal mind, devoted to matter; pride; envy; fame; illusion; a false belief; error masquerading as the possessor of life, strength, animation and power to act; renewal of affections; self-offering; an improved state of mortal mind; the introduction of a more spiritual origin; a gleam of the infinite idea of the infinite principle; a spiritual type; that which comforts, consoles and supports" (pp. 572-3).

"*Earth*: . . . To material sense, earth is matter; to spiritual sense, it is a compound idea" (p. 576).

"*Hiddekel* (river): Divine Science, understood and acknowledged" (p. 579).

"*Euphrates* (a river): Divine Science encompassing the Universe and man; the true idea of God"; etc., etc. (p. 576).

"*Gihon* (river): The rights of woman acknowledged—morally, civilly and socially" (p. 578).

"*Wine*: Inspiration, understanding, error, fornication, temptation, passion" (p. 589).

These selections suffice to give the general tenor of Mrs. Eddy's interpretation of the Bible.

The theology of Christian Science is not the theism of the Christian religion which looks upon God as "more than the sum of all things, but as intimately present with all things, so that all energy is an immediate manifestation of God" (Bates). On the contrary, Christian Science is almost a pure pantheism, although Mrs. Eddy vehemently denies it. Where it falls short of absolute pantheism, is in the denial of the existence of matter.

As an ethical system, Christian Science approaches more closely to the subjective idealism of Berkeley than to any other system. But it is not a subjective idealism, because it denies individuality and personality—prerequisites, of course, to Bishop Berkeley's system.

It may then be called a "Pantheistic Idealism" or an "Idealistic Pantheism." (W. B. Greene, "Christian Science, or Mind-Cure.")

In connection with this philosophy it is of interest to note that free will is impossible; that thought is precluded, for it requires mortal mind which is unreal; and that all the phe-

nomena of sense, *i. e.*, the data of universal human experience, are declared false and unreal.

There is one incorporated Christian Science college, that of Mrs. Eddy, in Boston. The other institutes, etc., where it is said that Christian Science is taught and cures effected, apparently occupy the position of primary schools of Christian Science. In the Massachusetts Metaphysical College there are three courses: one leading to the degree of C. S., the second to the degree of C. S. B., and the third to C. S. D. Each of these courses consists of a series of about 16 lectures and costs the pupil \$100. In addition, there is a course by a certain Dr. Baker, a regular practitioner, who is a convert to Christian Science. Dr. Baker gives a shorter course, *i. e.*, less than 16 lectures, in which he undertakes to teach to the senior grades some practical medical procedures. This course consists entirely of lectures without any hospital or laboratory training.

In their every day life Christian Scientists drop, to a great extent, their belief that matter is non-existent and a false belief of mortal mind. They eat, dress, live in houses, walk through doorways instead of theoretically non-existent brick wall, and in general live the same life, subject to the same conditions as the most materialistic of us.

While they assert that all the data of human experience in relation to the outside world are false, and no more true and actual than are dreams, still, they consider it best, under the present circumstances, to accept things as they are. Accordingly, they approve of education—even of advanced education—in history, philology, sociology, and even in some of the sciences. They positively refuse to have any dealings with the biological sciences, or with anything that gives a knowledge of the structure or action of the human body, of the action of drugs, or of the study of diseases. They say that the more these subjects are studied the more impossible it is for the student to acquire the proper belief in the totality of Divine Mind and the falsity of matter, disease and death.

Upon the problems of death and the origin of life, I cannot make clear to you the Christian Science views. To questions that I asked upon these points, I was told that it required years of study of Mrs. Eddy's system in order to arrive at a correct understanding. The stumbling-block with me is briefly set forth. In the first place, as all Christians believe in the immortality of the soul, that question need not be considered as a special Christian Science problem, and it only remains to deal with the body. Can Christian Science save the body from death? Now, Christian Science states that there is no body, but only a false belief—a belief, moreover, which can be and is to be obliterated. If the body is obliterated, how is Christian Science to save it from death? It reminds one very much of the grin without the cat that surprised Alice in Wonderland.

Similarly with the origin of life. Every new individual born is only another false belief. But in a natural state each individual is a part of Divine Mind. How, then, does Divine Mind, which denies evil, come into association with this false belief? It is another way of putting the question suggested earlier in this paper: If the original man is part of All Good, as Christian Scientists tell us, having no activity nor volition,

except from Divine Mind, how can the evil mortal mind originate? This has never been explained, so far as I know.

Let us now consider

2. CHRISTIAN SCIENCE AS A SYSTEM OF MEDICAL PRACTICE

At the outset we are met by the question just considered. If the body is a false belief, and sickness is a false belief, what would be the effect if the patient returned to a condition of harmony with Divine Mind? Why should not body be nullified as well as sickness?

Christian Science denies the utility of medical knowledge and medical methods, and refuses to use drugs, surgery or any therapeutic agent other than Divine Mind. The study of any medical science is reprehensible. They abhor diagnosis, for Mrs. Eddy says that the diagnosis of a disease tends to bring on the disease. They utterly disapprove of hygiene, cleanliness, antiseptics, vaccination, the isolation of contagious diseases, and, in general, of all those methods ordinarily considered useful in the prevention and relief of disease. They undertake to cure every form of disease by inducing the patient to disbelieve in its existence and acquire faith in their God. Not only do they undertake to cure adherents of the system, however, but also non-believers; that is to say, a person who does not believe is cured by his belief.

The method employed has been described above.

Mr. Hering says that he has had about 80 per cent of cures, including those cases given up by regular practitioners. This percentage is almost surely incorrect. The Rev. Oliver Hnckel estimates that 5-15 per cent are cured in Christian Science.

The reasons for supposing that Christian Scientists claim more cures than they effect are the following:

1. They keep no records of cases and, therefore, cannot note accurately what changes occur in the patient.
2. They make no diagnosis of disease, and, therefore, there is no assurance that they have treated the diseases claimed.

3. They make no examination of the patient after treatment, and, therefore, there is no proof that they have effected the cure claimed.

Dr. Huber, in New York, had a chance to examine some "cures" and found absolutely no basis for their claims. All attempts to get proofs of their good results have failed. Mr. Purrington attempted to get them from Mr. Carol Norton. The proofs consisted in short statements by the Christian Science healers.

There is, however, no doubt that a certain number of cases recover. These recoveries depend upon two chief factors:

In the first place, as is well known, the majority of sick people recover without, or in spite of, treatment. This is a well-recognized fact. Such cases are regarded by Christian Scientists as cures due to their methods. The second factor is undoubtedly the method employed by Christian Scientists. The cures from this are, in all probability, but a small proportion of the whole.

Now, the important question is: What is their method? Have they added anything new to the stock of medicine?

knowledge? I think there can be no doubt that they have not.

In spite of the most vigorous denials by Mrs. Eddy; in spite of the most solemn assurances from Mr. Hering that I do not understand the case; I can not escape from the conviction that the only therapeutic agent at work in Christian Science is mental suggestion. The fact that the healers and patients are firmly convinced that each cure is a divine manifestation, does not weaken, but indeed supports this idea. The reasons for this conclusion are numerous:

At one time Mrs. Eddy was a homoeopathic practitioner and employed the greatly diluted preparations of that cult. She found that she could obtain just as good results by giving no drugs as by using the weak drug. This put her on the track of Christian Science, and this is nothing in the world but pure mind-cure, or mental suggestion. Moreover, she constantly illustrates the action of Christian Science by references to this feature of homoeopathy.

Secondly, Mrs. Eddy was at one time under treatment by a Dr. Quimby, who employed hypnotism. Her text-book appeared about a year after his death.

The strongest evidence that Christian Science is mental suggestion with a different name is furnished by her method of employing it. The patient is told to be calm, and is assured that all will go well; that he must try to aid the healer by believing that what is told him is true. The healer then, quietly, but firmly asserts and reiterates that there is no pain, no suffering, that it is disappearing, that belief will come, that the patient is getting well. As an aid to render the patient more susceptible, an appeal is made to that most potent agent, religious fervor.

If the name were not given, one would suppose that the description was not of Christian Science, but of hypnotism. It is not improbable that the subjects are, at times, actually hypnotized.

The Rev. Mr. Huckel's statistics also are in favor of the mental quality of Christian Science healing. He finds that Christian Science has about the same percentage of cures that are effected by other mind-cures, as at the various Catholic shrines; by avowed mind-healers, and in the cases treated with bread-pill medicines.

There is no point upon which a Christian Scientist is more emphatic than in denying that Christian Science healing is due to mental suggestion. According to Mrs. Eddy, Carol Norton and those Christian Scientists with whom I have conversed, the healing is effected not at all through mental suggestion, not through any miraculous intervention, involving a departure from the normal course of nature, but by the natural, ever present action of the Divine Mind. The cures of Christ (which they deny were miraculous) were of the same character.

Healing, as they practice it, is not only the privilege of every Christian; they claim that Christ has made it a duty for every one of his followers to "heal the sick" (Matt. x, 8), a duty as binding as any other Christian observance.

There is one feature of Christian Science healing that I have delayed mentioning, because I wanted to give it especial prominence, that is, the Christian Science treatment of

children too young to be given the "argument treatment" as it might be called.

Incidentally it may be noted that the same treatment is employed to cure children, animals and plants.

The Christian Scientist goes upon the assumption that, if the child is too young to have false beliefs himself, any illness that may overtake him is the result of false belief on the part of his parents or of those in charge of him. Therefore, when summoned to attend a child the Christian Scientist pays absolutely no attention to the child, but proceeds to convince the parents that there is nothing the matter with it; that there is only a wrong belief in their minds which they must dismiss if they wish the child to recover. This is the only treatment given. No matter (as has happened) if the child is suffocating with diphtheria, no matter if he is suffering from the most fatal digestive disturbances, no matter if he is racked by whooping-cough, or covered with the eruption of scarlet fever, the treatment is the same. In no case do they recommend any medicinal treatment, nor attempt to alleviate in any way the infant's distress. And all this, in the name of Religion!

Let us now look at Christian Science as a whole. We see that the head of the movement is a woman, who is considered by some to be the victim of a form of insanity, known as paranoia; a woman whom many more consider simply an impostor, growing rich at the expense of her deluded followers; a woman evolved from homoeopathy, who claims the powers of Divinity.

We see that this woman has built up a system showing the utmost crudeness of construction, full of inconsistencies and self-contradictions; displaying, at every turn, the author's ignorance of the meanings of words, her confusion of ideas and complete inability to reason logically. We see the head of this system guilty of horrible blasphemy. We see her denouncing as false the findings of all human experience, and we see her arrogantly vaunting herself as the only human being with true knowledge, and on every page of her book boasting of her superior wisdom. We see the members of this school making the most extravagant claims of their power over disease; we see them, in the name of religion, stand passive at the bedside of suffering infancy; we see them, in the name of religion, attempting to undo all that has been accomplished by millions of earnest workers and thinkers to better the conditions of human life.

On the other hand, we see this sect growing like a mushroom. We see that thousands of rational people accept Christian Science *in toto*; that it numbers among its followers judges, lawyers, doctors, ministers, business men and people of all classes. We see them devoting to it their time, their enthusiasm and their money. We see people, whom it would be ridiculous to call insane, refusing any other assistance in their most serious illness and relying upon the efficacy of Christian Science to save their children from the grave.

How can we account for this curious condition? What gives Christian Science its strength? Is there any way in which to explain its existence?

If we try to account for the immense following of Christian Science and its strength by the intrinsic merits of its teaching

and work, we must remain unsatisfied on account of the insufficiency of motive.

Christian Science appears to have no points in its favor that are original or peculiar to itself. The idea that disease is a work of evil, or—in the Christian Scientist's nomenclature—of mortal mind, is as old as history. This idea of sin as a work of the devil, is seen in the histories of all the ancients; it occurs in the Bible; it was the thought that prompted the treatment of insane people in the olden times when they were put in mad-houses and frightfully abused in order to drive out the evil spirit, and it is not an uncommon thing to see evidences of the same idea nowadays.

Again, the most attractive feature of the Christian Science religion is the manner in which they insist upon the healthfulness and necessity of cheerfulness, composure and self-forgetfulness. Their religion teaches them to forget their own sufferings and distresses and to take an interest in outside things.

But this cannot account for the strength of Christian Science, for this is not a new doctrine. The same thing is being brought more and more to the front as an essential part of personal religion by the churches throughout the land.

Again, the only idea brought forward by the medical teaching is the efficacy of mental suggestion as a therapeutic agent. But this is by no means new. There is no one who denies its utility; it is employed, consciously or unconsciously, to a very wide extent, while one branch of it—hypnotism—is steadily growing in importance as a therapeutic agent.

But if we cannot find the *raison d'être* of Christian Science in its intrinsic qualities, how is it explicable?

This brings us to the consideration of a curious phenomenon presented by society. It is a phenomenon that has occurred from time to time since the foundation of society, and consists in the rise and enormous popularity among reasoning people of ideas that are utterly irrational, or contain but a grain of reason. It is the same phenomenon illustrated by the original spread of homoeopathy, of Thompsonianism, of Perkinism, of theosophy, of Schlatterism, and by the history of many more popular fallacies, either defunct or passing.

I regret that I can do no more than touch upon this subject. There are certain factors that may be considered to afford a particularly fertile field for the growth of Christian Science.

In the first place, there is always an element in the community whose tendency is to go to extremes in adhering to their ideas. A person of this class, being convinced of the truth of that portion of Christian faith which teaches the universality of God, will apply his belief blindly to every case, without regard to any evidence that fact and reason may oppose.

Secondly, the great improvements in the material comforts of modern life and, also, the great development of the natural sciences, with their rigid demonstration of material origin and causation, are (at least in part) responsible for the materialism that so widely pervades modern thought. It is only natural that there should be a reaction from this materialism and from its causes, to the extremes of idealism.

In the third place, there are always people eager for something new, seeking for miracles and ready to believe it possible

to obtain that complete mastery over nature, that Faust despaired of acquiring after a life of endeavor.

The chief basis for the growth of Christian Science, however, is the same that underlies every popular pseudo-science. Oliver Wendell Holmes outlines very clearly the factors concerned, showing (*a*), how easily abundant facts can be collected to prove anything whatsoever; (*b*), how insufficient, "exalted wisdom, immaculate honesty and vast general acquirements," are to prevent an individual from having the most primitive ideas upon subjects out of his line of thought, and, finally, demonstrating "the boundless credulity and excitability of mankind upon subjects connected with medicine."

The same conditions referred to in Holmes' essay are responsible for Christian Science. Furthermore, Christian Science is partly a religious mania (though the title of the text-book shows the relative importance of its medical and religious doctrines).

A further source of strength in Christian Science is the confidence with which the teacher assures her followers that they are the only profound thinkers in the world, and makes them believe that the adoption of her ideas is a mark of superiority separating them from the ordinary masses.

Such being the status of Christian Science, what may we conclude as to its future?

There is no doubt that the only grain of truth that supports Christian Science is its employment of mental suggestion. It is probable, also, that mental suggestion has a much wider field of application than it receives at present. It is not improbable, I think, that, as regular practitioners develop the possibilities of suggestive therapeutics more and more, they will cut away the only prop that can hold up Christian Science; though it will almost surely disappear even without such deprivation.

It is really no stretch of the imagination, to predict that our generation will see the decadence of Eddyism and the rise of another pseudo-science just as impossible as Christian Science, and just as powerful.

Christian Science is very shrewdly planned to give it the strongest and most permanent foothold possible. The regulation, limiting the right to perform the marriage ceremony to the converted ministers from other churches illustrates this, and features of their medical system serve as better illustrations.

In the first place, although they claim to cure all diseases, Mrs. Eddy advises them not to deal with surgical cases. The reason for this is obvious. The good or bad results of treatment in surgical cases, as for instance fractures, are much more evident to the ordinary person than are the results from medical diseases, as typhoid fever; and bad results in such cases would lay the Christian Scientist open to prosecution in court. Again, Christian Scientists, when called in to treat cases, profess the utmost willingness to allow regular practitioners to be summoned (though they advise their followers of the wickedness of such procedure); they refuse to charge fees for services rendered (though Mrs. Eddy has stated that "Christian Science demonstrates that the patient who pays whatever he is able to pay for being healed is more apt to recover than he who withholds a slight equivalent for health") (Miscel-

aneous Writings); they give no remedies nor medical advice; for that would subject them to prosecution. And, finally, they claim that they themselves are not the effectors of cures, but the agents of God, and that to interfere with their medical practice is to interfere with their freedom of conscience, and right to pursue their religious teachings.

In concluding, I must state what seems to be the proper attitude for us to hold towards Christian Scientists.

There are really not many active measures that we need adopt toward this cult. The most rapid and efficient means of destroying them is to bring prominently before the public the manifest absurdities of the school, and the dangers attending its spread. Severe measures would tend to strengthen their hold by putting them in the position of persecuted martyrs. There are, however, three points, that it is well to aim at in dealing with them.

1. To insist that they report to the Health Department all births, deaths and contagious diseases, and that, in the latter class of cases, they take proper means to protect the community.

2. To secure for small children the proper protection from Christian Science extravagances.

3. The third point is too big to be more than touched upon here, and deals with the regulation of medical practice in general; but, in brief, we should attempt to limit the right

to treat the sick to those who have given satisfactory evidence that they possess a knowledge of the conditions of health and disease, and who can show that they have the requisite training. These objects are to be attained by legislation to debar the ignorant from practice, and by prosecuting in the courts those who practice without the proper qualifications.

This is a very important question, and one that has been brought to the front already. There are numerous cases in which Christian Scientists have been prosecuted in various States, but up to the present they have escaped either upon the ground that they were not medical practitioners, but were simply meeting the demands of their religion, or upon a defect in the statutory definition of what constitutes the practice of medicine. Upon the first of the points the Supreme Court of the United States has declared that no one can violate the law under the cloak of religion.

The usual defect in the statutory definition of medical practice is that the giving of drugs or other medical treatment is considered necessary to make a person a practitioner, and Christian Scientists use no medical measures.

The questions involved here with a list of cases is very fully considered in a recent book by William A. Purrington, of New York.

TWENTY-FIFTH ANNIVERSARY OF DR. WELCH'S GRADUATION.

On the evening of May 4, Prof. Councilman of Harvard University, in behalf of the students and coworkers of Dr. Wm. H. Welch, at a complimentary dinner held at the Maryland Club, Baltimore, presented him, in honor of the twenty-fifth anniversary of his doctorate, a volume of contributions to the science of medicine, containing 38 papers, all embodying original research. (See page 138.)

ADDRESS OF PROFESSOR W. T. COUNCILMAN.

On this occasion, 25 years after your entrance into the medical profession, we, your students, present to you this volume. It contains a number of articles written by us, each of which contributes to the advancement of medical knowledge. We have chosen this method to tell you of our esteem and affection, for we feel that it is the highest and most enduring tribute we could lay before you. For, unlike any tribute brought in stone or metal, it has the quality of increase. The results of the investigations here set forth will stimulate further investigations and lead to still greater increase of knowledge. It is the work of men you have taught, who have come under your influence and who have received from you the inspiration which has enabled them, often amid great difficulties, to continue in the path along which you first led them.

It is one thing to tell a man what is the right way; it is better still to show him; but it is quite another thing to take him by the hand and lead him along it. This you have done, and it is this which has made you the great teacher which you are, for a teacher to be great must be a leader among men. You have taught us what is known. In your lectures you have presented to us, with a clearness that has never been surpassed,

the known facts of medical science and the deductions to be drawn from those facts. We have learned from you the importance not of theory, but of definite knowledge. You have further showed to us that merely to acquire what is known is not the true aim, but that he who would himself advance and contribute to the advancement of his fellows must seek to enlarge the bounds of knowledge. By your own work you have led us. The importance of the work you yourself have done is recognized by the world. It has been marked by your characteristic clearness, thoroughness and fairness. In the work which you have inspired, there has been absolute freedom in the worker. You have always sought to turn their investigations into the development of truth.

The work has been in a broad field, and the workers have had a clear sky above and fresh breezes around them. All branches of medical science have been enriched by this work. The breadth of the work is shown in the subjects treated in this volume. We feel that you are a part of it, that our work is due to your inspiration. But your work as a teacher and leader has not been confined to those who have felt your presence; it has been far wider. Your influence has been felt in every part of the country, because each man who has gone from you has been a missionary burning to lead others into the light.

One year after your graduation, The Johns Hopkins University opened its doors. The central idea of the university, the idea with which it started, which distinguished it from other institutions of learning in this country at that time and gave it at once its high position in the world, is that it is the duty of a university both to impart knowledge and to increase knowl-

edge by original research. In the medical education at that time there were no high ideals. There were numerous schools in which the medical art was taught, but in no place had the university ideal, which aims at the advance of knowledge, entered into medical education. Not that there were not a few great teachers, but the principle was not there.

The creation of the Medical School of the University was slow. First physiology and then pathology were established as departments of the university. Sixteen years ago, Dr. Welch, you were called to the chair of pathology in the university. There was no hospital to furnish material, no students to teach. You began your work, and before the hospital was opened you had grouped around you an earnest band of workers. Those of us whose fortune it was to have been with you in those early days can never forget them.

When the Medical School was opened, the ideals of the university had been established in its most important departments and were a controlling power. There sprang up at once that close union between the university and the medical school to which, more than anything else, the marvelous growth and influence of the medical school has been due. The medical school was founded in the laboratories of physiology and pathology. There has been in the medical school and in the hospitals a close union between art and science, an appreciation of their mutual dependence, which in its fullness was new to America.

We have ourselves tried to do what we could to advance knowledge and to extend to others the ideals which we learned from you. Your spirit lives in us, and we extend to you in this work the best expression of our affection, our esteem and our gratitude.

ADDRESS OF PROFESSOR WELCH.

On accepting the volume, Dr. Welch replied as follows:

My friends and fellow students:—I have no words adequate to express my appreciation of this demonstration of your affection and loyalty. With a heart full of thanks I accept this magnificent volume of contributions to medical science by my pupils and coworkers, now and in the past.

I thank you, Dr. Councilman, for your generous words in presenting this volume, even if I must believe that your estimate has far exceeded my merits. Although I have been kept in ignorance of the details of this undertaking, I know that my especial thanks are due to Dr. Mall and Dr. Flexner for its inception and conduct, as well as for the incentive to several of the contributions. Turning the pages, I see how much is due to the marvelous artistic skill of Mr. Broedel, and I am not surprised to hear of the unselfish devotion of Dr. Hurd in the editorial work, nor that my old friend and colleague, Dr. Halsted, has been active in arranging for this occasion. To all who have honored me by their contributions to this volume I am deeply grateful, and the kind messages from many other pupils and associates have gladdened me.

Nothing could afford me livelier pleasure and satisfaction than to have my name associated in this way with a volume of contributions, which cannot fail to interest all workers in scientific medicine. I recognize among the contributors not only the names of those who have gained distinction as inves-

tigators, but also of those who are beginning their careers and will now win their first spurs. To me the most significant feature of this occasion is that the time has come in America when a group of investigators, more or less closely connected through common teachers, can bring together so large a number of important, original contributions to medical science. Twenty-five years ago this would not have been possible. That I should have been permitted to participate with others in bringing about this advance is to me a source of much gratification.

When Dr. Prudden and I first started our small laboratories in New York, he at the College of Physicians and Surgeons, and I at the Bellevue Hospital Medical College, the outlook was not encouraging for a young man to select pathology for his career. The contrast between then and now in this respect is indeed a striking one. To-day, pathology is everywhere recognized as a subject of fundamental importance in medical education and is represented in our best medical schools by a full professorship; at least a dozen good pathological laboratories, equipped not only for teaching but also for research, have been founded; many of our best hospitals have established clinical and pathological laboratories; fellowships and assistantships afford opportunity for the thorough training and advancement of those who wish to follow pathology as their career; special workers with suitable preliminary education are attracted to undertake original studies in our pathological laboratories; students are beginning to realize the benefits of a year or more spent in pathological work after their graduation, as a foundation for future success in practical medicine, surgery, or the specialties; and as a result of all these activities the contributions to pathology from our American laboratories take rank with those from the best European laboratories. While we realize that we are only at the beginning of better things and that far more remains to be accomplished than has been attained, nevertheless, the progress of pathology in America during these twenty-five years has surely been most encouraging.

When I look back over this quarter of a century I realize how favored I have been by my opportunities, and here you will permit me to be somewhat personal. My interest in pathologic anatomy was awakened in my student and hospital days by Delafield and Jancway, who are among the best pathologic anatomists whom I have ever known. I received also a strong stimulus toward scientific work from Jacobi, whose seventieth birthday will be celebrated to-morrow night in New York by well-earned honors. I owe more than I can tell you to my teachers in Germany, to Cohnheim, Weigert, von Recklinghausen and Wagner, and through them to the great master, Rudolph Virchow. Upon my return to this country, my association with Dr. Austin Flint, the elder, was to me an inspiration, and in many ways of the greatest advantage.

While the prospects for earning a livelihood and for advancement in a pathologic career may not have seemed encouraging in New York, 22 years ago, in reality the circumstances were fortunate. About that time there were introduced great improvements in histologic technic, which led to a deeper insight into the structure and activities of cells and opened the way for new directions of development. Above all, it was the begin-

ning of the bacteriologic era marked by the great discoveries of Koch, of whose earliest work I saw something while studying in Cohnheim's Laboratory in Breslau, and whose personal teaching I later enjoyed. To have begun one's work as a teacher of pathology at such a period and after intercourse with such masters of the science, and to have been permitted to continue it during these years of unparalleled progress, must be considered a circumstance fortunate for the teacher.

The time was fully ripe in this country for the introduction of laboratory teaching and investigation in pathology, and it is certain that if one had not appeared to undertake it, another would have done so. It was an easy matter under such circumstances to demonstrate the value of the pathologic laboratory in medical education. I have every reason to feel grateful for the encouragement and support accorded the little laboratory at Bellevue College and the opportunities there afforded to me. Prudden's Laboratory, founded about the same time at the College of Physicians and Surgeons, has developed under his masterly direction into a large and splendidly equipped laboratory, surpassed by none in its influence upon the advancement of pathology in this country. I need not speak here of the wider opportunities, so well known to you, which I found in Baltimore, of the liberal policy of the Trustees of The Johns Hopkins University and Hospital in the establishment and support of the Pathological Laboratory, of the advantages derived from the intimate association of the Medical School with this great University and Hospital, of the stimulus received from my colleagues, and of the attraction of our high standards of education in drawing to us highly trained students.

Above all, most fortunate have I been in those who have worked with me as pupils and associates, and to these co-workers is due in the first instance whatever of success has attended my efforts as a teacher and student of pathology. I am delighted to see here to-night my old friend and co-worker in the New York Laboratory, Dr. Meltzer, and also Dr. Beyer. To have had such a coadjutor in the early organization and conduct of the Baltimore Laboratory as Dr. Councilman, such an original investigator as Dr. Mall for the first fellow in pathology, such special workers in the early days of the laboratory as Sternberg, Halsted, Herter, Abbott, Bolton, Nuttall, Hooker, Miller, Barkley, Clement, Howard, Russell, Blachstein, Thomas, Williams, Randolph, Gilchrist, and others—all of this I count as the best of good fortune. I call to mind on this occasion with affectionate regard many others who have followed these earlier workers, but the list is too long to enumerate. I must, however, give expression of my indebted-

ness to Dr. Flexner, who since the opening of the Medical School until the end of the last academic year has been my closest associate in the work of teaching and in the supervision of the laboratory.

While it has been hard to part with such associates, it is a matter of pardonable pride that so many have been called to important chairs in other institutions—Councilman to Harvard; Abbott, Flexner and Clark to the University of Pennsylvania; Wright to the Laboratory of the Massachusetts General Hospital; H. U. Williams to the University of Buffalo; Blumer to the Bender Hygienic Laboratory in Albany; Bolton to the Hoagland Laboratory and subsequently to other institutions; Howard to the Western Reserve University; Nuttall to the University of Cambridge, England; Russell to the University of Wisconsin; and now we are to lose Barker, most scholarly, versatile, inspiring of teachers and profound in his studies, who has been called to an important position in the University of Chicago. That we shall retain with us young men of great promise is evidenced by such contributions as those of Cullen, Cushing, Young, Bardeen, the MacCallums and Opie in this memorial volume. I rejoice to see in this book in connection with Cushing's, the name of our much-loved Livingood, whose career of unusual promise was cut short by an ill-timed fate.

I should like to be able to speak of the value of the contents of this volume which you have dedicated to me, but I see it for the first time to-night. A glance through the pages assures me that here are gathered together papers with which any medical teacher in the world would be proud to have his name associated. I may be permitted to call attention to the importance of the contributions from our women students; and it will not, I trust, be invidious if I mention the superb work of Miss Florence Sabin, done under Dr. Mall's and Dr. Barker's direction, and so beautifully illustrated by Mr. Broedel.

As I have already said, I see in this volume of studies an index of the great advance during the last quarter of a century in the material conditions surrounding pathological teaching and investigation in this country, brought about especially through the establishment of laboratories. It is also a significant token of the greater things which we may assuredly expect in the future, when America will take her place in the front rank with those countries which contribute most to the progress of the medical and biological sciences. If my name shall ever be mentioned among those who in those earlier days have helped to promote our science in this country, I shall owe it above all to you, my pupils, colleagues, and fellow workers.

MONOGRAPHS.

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CONTRIBUTIONS TO THE SCIENCE OF MEDICINE DEDICATED BY HIS PUPILS TO WILLIAM HENRY WELCH ON THE TWENTY-FIFTH ANNIVERSARY OF HIS DOCTORATE.

TITLES AND ABSTRACTS.

I.

A Contribution to the Study of the Pathology of Early Human Embryos. By FRANKLIN P. MALL, Professor of Anatomy, Johns Hopkins University. With 6 plates and 29 figures in the text. (Pages 1 to 68.)

The paper is based upon the study of 50 pathological human ova which have been collected by the author during the past six years. Nearly all of the embryos were cut into serial sections, thus permitting of a more careful study than is possible from that of the external appearances alone. As far as possible, additional data were obtained from the physicians from whom the specimens were obtained, and these prove to be of much value.

The paper discusses the following subjects:

1. Arrested development of the embryo with continued growth of the ovum.
2. Degeneration of the embryo, leaving only the umbilical cord.
3. Ova, normal in form, without embryos and uterine moles.
4. Vesicular forms of pathological embryos.

It is followed by an appendix giving the main data of all of the normal embryos known as well as a detailed description of each of the pathological specimens discussed in the communication.

II.

On Urea in Some of its Physiological and Pathological Relations. By C. A. HERTER, Professor of Pathological Chemistry, University and Bellevue Hospital Medical School, New York. (Pages 69 to 109.)

The physiological portion of this paper deals (*a*) with experiments which were undertaken with a view to comparing the capacity of different types of kidney in the excretion of urea, and (*b*) with the experiments relating to the nature of the cell activity concerned in the excretion of urea.

The pathological section is devoted to a record of experimental observations on the following subjects: (*a*) the toxic action of intravenous infusions of watery solutions of pure urea, especially in dogs and monkeys, (*b*) the action of urea upon experimentally damaged kidneys, (*c*) double nephrectomy and its effects upon the urea content of the blood, muscles, liver and brain, (*d*) insufficiency of urea in the course of renal disease, (*e*) the relation of an excess of urea in the blood (literal uræmia) to uræmic states. Evidence is brought forward in this section of the paper which indicates that a large excess of urea in the blood is capable of giving rise to disturbances which manifest themselves clinically, although in some examples of conditions included by clinicians as uræmic it is quite clear that urea can play no part in occasioning the symptoms.

III.

The Direct Action of Nicotin upon the Mammalian Heart. By HENRY G. BEYER, M. D., Surgeon U. S. Navy. With 9 figures in the text. (Pages 111 to 134.)

This paper gives an account of some experiments made upon the isolated heart of the cat with nicotin in blood in different degrees of strength; it also describes the effects of nicotin on the dog's apex on which two experiments were made; finally, several experiments are recorded in which nicotin in blood was allowed to run through the coronary vessels while the heart was in a state of fibrillation.

The experimental evidence brought out seems to warrant the following conclusions, namely:—(1) Nicotin acts as a powerful stimulant on the vagus nerve endings as well as on the accelerator or augmentor nerve endings in the heart; (2) it increases both the tonus and the irritability of the muscular fibres of the heart and, lastly, causes the contraction of the coronary vessels.

IV.

The Effect of Shaking upon the Red Blood-Cells. By S. J. MELTZER, M. D. New York. (Pages 135 to 151.)

The conclusions reached are as follows:

1. Shaking of even a very short duration has a detrimental effect upon the red blood-cells, which manifests itself by an early separation of the hæmaglobin followed by a rapid breaking down of the stromata into dust.
2. The process of defibrination is invariably very injurious to the life of red blood-corpuscles.
3. Prolonged shaking of the blood with a granulated insoluble substance turns the red blood-cells into fine dust. Cells of different animals show different degrees of resistance. The destruction is due to a molecular shock and not to a gross injury. The continual shaking beats together again the fine dust into large granules and dust. Possibly the molecular destruction is characteristic of organized elements.
4. Certain degrees of shaking can also prolong the life of the red cells, but the degree which is favorable to the life of the cells of one species of animal may be detrimental to the cells of another species.

These relations present a special instance of the general law formulated by the writer for the relations of vibration to a living organisms; for each individual form of life there is a minimum degree of vibration which is indispensable and another degree which presents the maximum limit.

V.

The Blood-Vessels, Angiogenesis, Organogenesis, Reticular and Histology of the Adrenal. By JOSEPH MARSHALL FLINT, Baltimore. With 8 plates and 28 figures in the text. (Pages 153 to 228.)

The adrenals are situated in what may be termed the vascular crossroads of the abdomen, for within a few centimetres from them the large trunks which supply almost all of the abdominal viscera are given off. Most of these contribute to the circulation of the glands which may be divided into three systems of vascular units, supplying respectively the capsule, cortex and medulla. In the capsule, there is an arterial and a well marked venous plexus. From the former the branches which supply the entire organ are derived. The blood-vessels of the cortex consist in the main of parallel capillaries with transverse anastomoses which empty into the venous tree of the medulla; while the arteries supplying the medullary substance pass entirely through the cortex to ramify in the medullary portion of the gland, giving off in their course arterioles and capillaries which empty finally into the branches of the venous tree, or into medullary veins which join them. The venous tree itself flows into the lumbar vein at the hilus of the gland.

This complex vascular system, following partially known lines, can be traced by means of injected embryos in its gradual evolution from the simplest to more complex stages, until finally the adult arrangement is reached. Curiously enough, the medulla is developed outside of the cortex and grows into the cortex after the latter is well formed, the various steps in this disposition being beautifully shown in stained or injected adrenals of embryo pigs. Of especial interest is the fact that simple mechanical misplacements may lead to anomalies of structure in the adult gland, occurring during the migration of the medulla, which are unintelligible in the adult organ unless viewed in the light of their formation.

The framework of the adrenal is made up of reticulum which can be studied best by some of the destructive methods. The reticulum fibrils have a definite arrangement in relation to the cells and blood-vessels, which they support and hold in position. Finally, the architecture of the adrenal is described most fully from the conditions found in the dog, where such variations of structure as transposed cortex or misplaced medulla are explained by the ingrowth of the medulla followed in the organogenesis of the gland in a series of experiments on embryo pigs.

VI.

Specific Degenerations of the Cortical Arteries. By HENRY J. BERKLEY, M. D., Clinical Professor of Psychiatry, The Johns Hopkins University. (Pages 231 to 236.)

VII.

Regeneration of the Crystalline Lens. (Alvarenga Prize Essay, 1899.) By ROBERT L. RANDOLPH, M. D., Baltimore. With 6 figures in the text. (Pages 237 to 263.)

The subject attracted the attention of investigators seventy years ago. Since then several have busied themselves with the problem, but within the past thirty years nothing of importance has appeared in connection with it. It is surprising to find that a histological problem of such importance finds no mention in either works on anatomy or ophthalmology. The object of this work is to ascertain whether the lens of the eye is regenerated after its extraction—whether, in other words, a new lens is formed. The conclusions are as follows:

1. Regeneration of the lens in the rabbit's eye occurs *only when some portions of the lens are left behind at the extraction.*
2. Removal of the lens in capsule is followed by a negative result.
3. Panophthalmitis is followed by a negative result.
4. The volume of the regenerated lens may be equal to that of the original lens.
5. The regenerated mass is lenticular, though sometimes it is ring-shaped and at other times it is semilunar.
6. The reason why positive results occur so much less frequently than negative ones, is because we are unable to protect the animal from infection after the operation.
7. Theoretically one would suppose that the longer the animal were allowed to live the greater would be the volume of the regenerated mass. This, however, was not the case in these experiments. In one instance where an animal was killed fifteen months after the extraction of its lens, the regenerated lens was about equal in size to that seen in another case where the rabbit was killed after six weeks. It may be added that there was no apparent reason for this.
8. A *mild* iritis, lasting for a week or ten days after the operation, is conducive to a successful result. This may be explained by the increased vascularity of the parts which lie next to the lens.

The second portion of the paper is devoted to a consideration of the works of Wolff and Erik Müller. The former made the statement that the lens of the triton (salamander) is regenerated from the iris epithelium and Müller confirmed Wolff's results. The author made fresh observations and reaches the following conclusions: 1. In the case of the newt, extraction of the lens is followed by its regeneration. 2. Regeneration occurs even when the lens has been removed in its capsule, so that the new lens must take its origin from tissue having a different physiological value; and, as the experiments of Wolff have shown, this structure is the iris.

VIII.

The Histology of Acute Lobar Pneumonia. By JOSEPH H. PRATT, M. D., Boston. With 1 plate. (Pages 265 to 277.)

Early in the disease the alveoli contain many cells almost identical in appearance with the so-called transitional cell of the blood. They are usually slightly larger than the polynuclear leucocyte, and contain an irregular vesicular nucleus, surrounded by a rim of protoplasm, containing either a few granules or none at all. In a case in which death occurred eleven hours after onset, there were great numbers of these cells in the exudate and no polynuclear leucocytes.

Large phagocytic cells are found in all stages of the disease, but in greatest number in gray hepatization. The inclusions consist chiefly of polynuclear leucocytes and lymphocytes, more rarely of red blood-corpuscles. These phagocytic cells probably play an important part in resolution. Similar cells are found in the lymphatics, in the pleural exudate, and in the bronchial lymph nodes.

The fibrin is not formed by a degeneration of the alveolar epithelium, but comes exclusively from the exuded blood plasma.

The lymphatics are involved late in the disease. There is proliferation of their endothelium, and they become distended with cells, serum and fibrin.

Early in the disease there is no infiltration of the interstitial

tissue. In cases dying during the second week, there is often a great infiltration with lymphoid and plasma-cells. As a rule the longer the duration of the disease the greater the number of plasma-cells.

These results are based upon a study of fifty cases of typical lobar pneumonia.

IX.

Bilateral Cholesteatomatous Endotheliomata of the Choroid Plexus. By GEORGE BLUMER, M. D., Director of the Bender Hygienic Laboratory, Albany, N. Y. With 1 plate. (Pages 279 to 289.)

X.

Concerning the New Formation of Elastic Fibres, Especially in the Stroma of Carcinomata. By HERBERT U. WILLIAMS, M. D., Professor of Pathology and Bacteriology, Medical Department, University of Buffalo. (Pages 291 to 296.)

Our knowledge of the condition of the elastic fibres in normal and pathological tissues has recently been much improved by the discovery of selective staining processes. Weigert's method was used by the writer with most satisfactory results. A review of the literature of the subject shows that newly formed elastic fibres have been found in the intima of the arteries in arteriosclerosis and endarteritis, in chronic productive inflammations of the serous membranes, in cirrhosis of the liver, in chronic interstitial nephritis, and in certain scars and tumors of the skin.

The writer endeavored to determine whether newly formed elastic fibres constituted a part of the stroma of carcinoma. Thirty-seven carcinomata growing in various organs were studied, with the following conclusions:

1. When the stroma of carcinoma is itself of new formation it is usually free from elastic fibres.
2. Newly formed elastic fibres may occur in the stroma, though rarely, and they are likely to be fine in quality and small in number.
3. The tumors, in which newly formed elastic fibres occurred, either contained a large amount of connective-tissue stroma, or the newly formed elastic fibres were in connection with preexisting elastic elements of the original parts.

XI.

Cirrhosis of the Liver of the Guinea-Pig Produced by a Bacterium (*Bacillus Coli Communis*) and Its Products. By GEORGE H. WEAVER, M. D., Assistant Professor of Pathology, Rush Medical College, Chicago. With 2 figures in the text. (Pages 297 to 305.)

The injurious agents which act acutely upon the liver affect the cells of the liver and bile-ducts, the character and strength of the agent determining the degree of injury produced. Only two substances which act in a chronic manner stimulate the growth of connective tissue. An important factor in determining the effects of injurious agencies upon the liver is to be found in the peculiarities of the tissues of the individual. The organism studied belongs to the group of colon bacilli. The live cultures and those which had been devitalized by heat when injected into guinea-pigs produced exten-

sive cirrhoses in the liver of the animals. The early changes were in the form of necrosis, the connective-tissue proliferation following a little later.

XII.

On the Muscular Architecture and Growth of the Ventricle of the Heart. By JOHN BRUCE MACCALLUM, Baltimore. With 24 figures in the text. (Pages 307 to 335.)

By the study of embryonic hearts of various ages, macerated in nitric acid, the organ was found to consist of several layers of muscle, the course of which is described in some detail. Nearly all the fibres begin in the auriculoventricular ring of one ventricle, and end in the papillary muscles of the other. Those fibres which begin near the outside of one ventricle end near the inside of the other ventricle. The thin superficial layers being removed, the left ventricle can be unrolled so that its cavity and papillary muscles are exposed. This shows it to be a flat band of muscle continuous with the muscle fibres that cross over in the septum from the right ventricle. Grouping these layers together it is clear that the heart in the embryo is a scroll-shaped band of muscle with tendons at each end. As it grows older the layer of muscle passing over in the septum remains comparatively thin, while the ventricular walls increase greatly in thickness. The growth takes place mainly near the inside of the ventricular walls, as shown by the presence of karyokinetic figures near the endocardium and by the fact that the muscle-cells in this situation are younger in an actively growing heart than those near the surface of the organ. These growing points must therefore be at the two ends of the unrolled heart. The heart, then, resolves itself into a flat band of muscle with a growing point at either end.

XIII.

Some Observations upon the Anatomy of the Gall-Bladder and Ducts. By GEORGE E. BREWER, M. D., Assistant Demonstrator of Anatomy, College of Physicians and Surgeons, New York. With 5 plates and 50 figures in the text. (Pages 337 to 354.)

In this paper are given the results of 160 dissections of the gall-bladder region in the adult human subject, which were carried out during the years 1898-99 at the anatomical laboratory of the College of Physicians and Surgeons (Columbia University), New York. These observations were originally undertaken by the writer with a view to familiarizing himself with the normal relations of the structures in this vicinity and of perfecting his technique in handling and suturing them. Noting numerous variations from the normal, and certain rather striking abnormalities which were of decided surgical interest, the writer extended his studies far beyond the limit originally intended. In addition, numerous observations were made on the size of the gall-bladder, the length and calibre of the ducts, the surgical relations of the duodenal orifice of the common bile-duct, and an effort was made to establish certain landmarks by which it may be rapidly located through an incision in the duodenum. Observations were also made with a view to establish landmarks by which the operator could rapidly locate and accurately mark at

position of the principal nerve-trunks likely to be injured in an incision through the abdominal wall in this region. In paper are also included observations upon the distribution of the hepatic artery, which are illustrated by fifty figures of dissections, showing numerous variations and many anomalies of interest to surgeons who are accustomed to operate in this region.

XIV.

Case of Plexiform Neuroma of the Eyelid (Rankenneuron). By HARRY FRIEDENWALD, M. D., Associate Professor of Ophthalmology, College of Physicians and Surgeons, Baltimore. With 2 plates. (Pages 355 to 357.)

The patient, female, was 16 years of age. The abnormality first noticed when she was a few months old. Two operations had been performed when she was a child. The right eyelid was greatly hypertrophied, especially in its temporal portion; the lower lid but slightly affected. There was almost complete ptosis and the thickness of the lid was greatly increased. Firm, round and corded masses could be felt under the skin and could be followed back into the orbit.

At the operation fine white threads characteristic of the tumor were found and removed. The growth was easily removed from the orbit with a blunt instrument and was found to extend much deeper into the orbit than was expected. The tumor was found to consist in great part of masses of whitish tumor tissue of varying greatly in thickness and weighing seven ounces. Sections showed the characteristic appearance of neuromata. Everywhere there were found smaller and larger bundles imbedded in a framework of connective tissue. For the most part smaller—bundles showed nothing abnormal. Others again presented varying degrees of hypertrophy of the endo- and perineurium with the nerve elements and more or less centrally, or with a few scattered axis cylinders in the periphery. There were other bundles again in which the hyperplasia was still greater, and in which it was difficult to recognize any nerve elements whatever.

XV.

Case of Multiple Myeloma. By JAMES H. WRIGHT, A. M., M. D., Pathologist to the Massachusetts General Hospital, Boston, Mass. With 3 plates. (Pages 359 to 366.)

XVI.

Development of the Musculature of the Body-Wall in the Pig, including its Histogenesis and Its Relations to the Myotomes and to the Skeletal and Nervous Apparatus. By CHARLES RUSSELL BARDEEN, M. D., Associate in Anatomy, The Johns Hopkins University. With 10 plates. (Pages 367 to 399.)

This investigation considers the development of the intrinsic abdominal musculature from the myotomes in the embryo. The histological changes taking place in the musculature are described, as well as the early relations of the musculature to the nervous and skeletal apparatus.

Three periods are recognized in the development of the musculature:

1. The period during which the myotomes expand dorsally and ventral processes into the *membrana reuniens*. The

cells, both of the mesial and the lateral plates of the myotomes are shown to be converted into muscle-fibres.

2. The period during which the tissue of the myotome, becomes utilized in the formation of the muscles characteristic of the adult. Segmentation is shown to persist only where the muscle-tissue remains throughout united to the vertebrae or to the ribs. The peripheral nerves are shown to develop independently of the myotomes, and to become associated directly with the musculature only after the muscles have become differentiated.

3. The period during which the muscles expand, become perfected in internal structure and are shifted into the relative positions characteristic of the adult.

Cell-multiplication takes place during the first two periods and during the early part of the third. Cell-division takes place by mitosis in round undifferentiated "myoblasts." From these the muscle-cells are developed by elongation of the cell-body, nuclear multiplication by direct division, and fibrillar differentiation of the protoplasm. The differentiated muscle-cells do not divide to form new cells. During the third period, however, many of the muscle-cells undergo retrograde metamorphosis.

XVII.

A Rare Variety of Adenocarcinoma of the Uterus. By THOMAS S. CULLEN, M. B., Associate in Gynecology, The Johns Hopkins University. With 3 figures in the text. (Pages 401 to 407.)

In the uterus we have three distinct varieties of epithelium: the squamous epithelium of the vaginal portion, the very high cylindrical pale-staining epithelium lining the cervical canal and the racemous glands, and the cylindrical ciliated epithelium of the body. From these three distinct kinds of epithelium three definite varieties of carcinoma develop. And, in fact, nearly all carcinomata of the uterus may be classified under one of the three varieties:

- (1) Squamous cell carcinoma of the cervix.
- (2) Adenocarcinoma of the cervix.
- (3) Adenocarcinoma of the body of the uterus.

The accompanying case differs materially from any that we have yet seen. Clinically, it is interesting to note the advanced age of the patient, who was 76 years old. There had been no hæmorrhages at any time and notwithstanding the extent of the growth the symptoms were of only one year's duration. On examining Figure 1, one is immediately impressed with the uniform involvement of the entire uterine cavity, the body being equally as much implicated as the cervix. The surface also presents dome-like elevations instead of the papillary or tree-like growths so common both in adenocarcinoma of the cervix and body. Another marked feature is, that notwithstanding the advanced age of the patient, the uterus is the size of a three-months pregnancy.

On histological examination the growth is found to be glandular in type. These glands are large and lined by one layer of high cylindrical epithelium, the nuclei of which rest directly on the basement membrane and the gland-cavities contain a homogeneous material that takes the hæmatoxylin

stain. In other words, both the glands and their contents resemble those found in the cervix.

XVIII.

A Bacteriological and Microscopical Study of over Three Hundred Vesicular and Pustular Lesions of the Skin with a Research upon the Etiology of *Acne Vulgaris*. By T. CASPER GILCHRIST, M. D., Clinical Professor of Dermatology, The Johns Hopkins University. With 1 plate. (Pages 409 to 430.)

Stained smears were examined from every lesion. A summary of the results is as follows:

Impetigo Contagiosa.—From every one of the 17 cases examined the streptococcus pyogenes was obtained, and in ten cases it was in pure culture. In 7 cases the staphylococcus pyogenes aureus also grew. The disease was reproduced in three cases by inoculating with a pure culture of the streptococcus obtained.

Ecthyma.—Two cases yielded pure cultures of streptococcus pyogenes.

Staphylococcia or Folliculitis Staphylogenes.—Sixteen cases examined: two cases yielded pure cultures of streptococcus pyogenes; in five cases the *S. pyogenes albus* was also present; in seven patients the *S. pyogenes aureus* was present in pure culture.

Tricophytosis.—In a case of *tinea barbæ* one culture yielded a pure growth of *tinea megalosporon ectothrix*, whereas in the second culture the *S. pyogenes aureus* was also present. By inoculation experiments on two men it was proved that the fungus was pyogenic and that therefore the pustular lesions of *tinea barbæ* may be produced by the fungus alone without the presence of the ordinary pus organisms. The same results were proven in a case of *tinea circinata* where pustules were present and a pure culture of the *tinea megalosporon endothrix* was obtained. It was also shown that the same fungus was the cause of pustular lesions on a boy's scalp.

Furunculosis.—From 20 cases pure cultures of the *S. pyogenes* were obtained in every case.

Scabies.—Nine cases; the staphylococcus pyogenes grew in pure culture in 4 cases; in 2 cases the *S. pyogenes aureus* was also present; the albus being present alone in the ninth case.

From beneath scales of pediculosis capitis and corporis, cultures of streptococcus pyogenes and *S. pyogenes aureus* and albus usually combined.

The *S. pyogenes aureus* grew in pure culture from 3 cases of *sycosis vulgaris*.

The pustular lesions of syphilis were shown, with two exceptions, to be due to mixed infections of the streptococcus and *S. pyogenes aureus* and albus.

Cultures were negative in 10 cases of herpes zoster (vesicles), 2 cases of sebaceous cyst, 15 cases of dermatitis venenata (vesicles), 4 cases of pernio (vesicles), 3 cases of erythema multiforme (vesicles), and one case of pemphigus pruriginosus.

Eczema.—Nineteen cases; in cultures from 6 vesicles, 5 were sterile, while one showed the *S. pyogenes albus*. In 13 cases of *eczema madidans*, 5 gave the staphylococcus pyogenes aureus alone, 4 yielded the albus, and 2 were sterile after

wiping the surface of the lesions. Out of 10 cases of pustular eczema, 2 gave the *S. pyogenes aureus*, 4 showed the albus, 4 cases yielded both aureus and albus, and one was sterile.

Acne Vulgaris.—This yielded the best results. 96 lesions from 54 patients were examined. 54 cultures were sterile, 31 showed from one to many colonies of staphylococcus pyogenes albus; 11 cultures gave pure growths of a bacillus in glycerin-agar. All the smears from the pus show bacilli. This bacillus grew slowly en masse in glycerin agar. The colony at first was creamy white, later it became pinkish then almost black in one very old culture. It grew on glucose agar without forming gas; grew in bouillon; invisibly in potato; grew fairly well on blood-serum, but not in Dunham or milk. It did not decolorize by Gram's stain, was motile and branched. It killed mice and guinea-pigs. Bacillus acnes was the name suggested for this micro-organism.

XIX.

The Frequency and Significance of Infarcts of the Placenta Based upon the Microscopic Examination of 500 Consecutive Placentæ. By J. WHITRIDGE WILLIAMS, M. D., Professor of Obstetrics, The Johns Hopkins University and Obstetrician-in-Chief to The Johns Hopkins Hospital. With 3 plates. (Pages 431 to 460.)

XX.

A Contribution to the Knowledge of the Bacillus *Aëroge Capsulatus*. By W. T. HOWARD, JR., M. D., Professor of Pathology, Western Reserve University, Cleveland, O. With 1 plate. (Pages 461 to 495.)

After a review the author reports thirteen cases of bacillus invasion, which he divides into three groups:

Group I. Bacilli entering the body through the genito-urinary tract—two cases. In one there were cerebrospinal meningitis and brain abscesses, both containing gas-cysts; general gaseous emphysema due to *B. aërogenes capsulatus*. In the second case, with abscess of the prostate, chronic cystitis, pyonephritis and gaseous emphysema, the bacillus was concerned in the renal lesions.

Group II. Bacilli entering through the biliary tract—two cases. In one the gas bacilli were limited to the gall-bladder and liver, and in the other—a case of typhoid fever—there was general gaseous emphysema, best marked in the liver and biliary tract.

Group III. Bacilli entering through lesions of the stomach and intestines,—nine cases, comprising the following lesions as the portal of entry: strangulated hernia; necrosis of stomach with gas blebs (typhoid fever); crushing injury involving the gastro-intestinal tract; intestinal ulcers (typhoid fever, two cases, lymphosarcoma, one case); and post-mortem disintegration of the stomach and ileum (four cases).

In the last four cases, microscopically, there were no gas-cysts found in the gastro-intestinal tract, which on macroscopical examination showed both cysts and bacilli.

The author next discusses the various modes of invasion, the destruction of the bacilli in the body and their removal upon the lesions.

XXI.

the Intravascular Growth of Certain Endotheliomata. By W. G. MACCALLUM, Associate in Pathology, The Johns Hopkins University. With 1 plate and 4 figures in the text. (Pages 497 to 510.)

The writer, after reviewing the records of several similar cases in the literature, gives the clinical history and autopsy protocol of a case which occurred at The Johns Hopkins Hospital. The tumor of the testicle was incompletely extirpated and at the autopsy, several months later, the extension along the spermatic vein could be traced into the vena cava, filling it with translucent papillary masses which extended to the heart. Large metastatic nodules were found on lungs, liver and elsewhere. The tumor was shown to spring from spaces with endothelial lining thought to be the lymphatic spaces. The proliferation of these cells produced not only cyst-like cavities but complicated cell masses. Especial interest attached to the relation of the tumor to the blood-vessels, as the intravascular papillary masses generally hung in the blood, and were overgrown by the endothelium of the vessel.

XXII.

the Cultivation of Amœbæ. By CASPER O. MILLER, M. D., New Market, Va. (Pages 511 to 523.)

Cultures were made in sterilized Erlenmeyer flasks with water containing a small percentage of organic matter. In most of the cultures living bacteria were present.

The fact that encysted amœbæ withstand drying was taken advantage of to eliminate from the cultures those protozoic forms which do not withstand drying. Algæ were eliminated by excluding the light from the cultures.

The amœbæ were gathered from various sources; of these they have been cultivated since 1889. Some cultures containing encysted amœbæ have been dried for six years without killing the amœbæ. Some of the amœbæ cultivated did not encyst. Of those encysting, two varieties have been studied: the spherical cysts—A. Sphærocystis; and the other forming irregularly shaped cysts—A. Irregularia.

In the culture of A. Sphærocystis, oval cysts resembling coccidia in many respects are found at times, and there are also occasionally present sharply defined, consecutive bodies.

Although it is not proven, at the same time it is questioned whether Amœbæ Sphærocystides, coccidia and the crescents, are not phases in the development of the same organisms. Those who have cultivated amœbæ on solid media only describe them as multiplying by division, but in the fluid cultures there are appearances which seem to indicate that amœbæ also multiply by segmentation.

XXIII.

Bacillus Pseudo-Tuberculosis Murium; Its Streptothrix Forms and Pathogenic Action. By DOROTHY M. REED, Baltimore. With 1 plate. (Pages 525 to 541.)

A study of the B. pseudo-tuberculosis murium first isolated by Dr. Welch in 1894; described by Kutscher in Germany in 1896; recovered in Baltimore in 1897, from a spontaneous case of pseudo-tuberculosis in a mouse.

This paper deals with the cultural properties of the organism, previously undetermined, with the study of the conditions under which the organism varies from its usual form of a simple rod in giving off side branches, and with the nature of the pathological lesions on the animal body. It is shown that the bacilli branch in the body and in artificial media; and that in the body aggregations of bacilli appear, which resemble the "Drüsen" of actinomycetes. In the tissue lesions the nodules differ from true tubercles, in being composed of bacteria and not of proliferated or emigrated body-cells.

XXIV.

Experimental and Surgical Notes upon the Bacteriology of the Upper Portion of the Alimentary Canal, with Observations on the Establishment There of an Amicrobic State as a Preliminary to Operative Procedures on the Stomach and Small Intestine. By HARVEY CUSHING, M. D., Associate in Surgery, The Johns Hopkins University, and LOUIS E. LIVINGOOD, M. D., Late Associate in Pathology, The Johns Hopkins University. With 8 figures in the text and 1 diagram. (Pages 543 to 591.)

From numerous clinical observations upon the character of the peritonitides consequent to perforating wounds of the alimentary canal it seemed probable that the severity of the infection bore a distinct relation to the situation of the perforation and that the favorability of the prognosis was proportionate to the nearness of the lesion to the stomach.

This suggestion, originating from clinical data alone, was the occasion of a series of experimental observations upon animals and human beings relative to the bacteriological features of the alimentary canal, especially of its upper portion. A great scarcity of micro-organisms was found to be the invariable rule in the neighborhood of the duodenum of the 35 dogs and rabbits which were examined under varying dietary conditions. With certain precautionary measures, such as sterilization of the ingesta and a fast of a few hours, a condition of amicrobism could almost without exception be brought about in the stomach and upper portion of the intestine of a healthy animal.

Adaptation to surgical procedures of the principles established by this experimental work has shown the feasibility, under a certain dietary régime, of rendering the upper portion of the alimentary canal practically free from micro-organisms in anticipation of operative work on the stomach and upper intestine, so that exposure of the lumen of the canal is unattended by risks of ensuing peritonitis.

XXV.

The Origin, Development and Degeneration of the Blood-vessels of the Human Ovary. By JOHN G. CLARK, M. D., Professor of Gynecology, University of Pennsylvania. With 5 plates and 11 figures in the text. (Pages 593 to 676.)

The author contributes a special research upon the ovarian circulation, in which the normal distribution of the arteries and veins of the ovary and their relationship to each other have been studied. At first sight the solution of this question did not appear to present greater difficulties than those en-

countered in the ordinary course of any research. A review of the sections of a few injected adult ovaries, however, at once demonstrated the futility of attempting to draw any conclusions from this source; for the close crowding together of the parallel vessels of the medullary portion, and the markedly irregular course of those in the cortex, or follicle bearing zone, rendered impossible any accurate observations concerning the relative number and distribution of the veins and arteries and the exact course followed by each system.

With a view, therefore, of securing ovaries possessing a simpler scheme, a study was made of the lower animals, such as the dog, rabbit, guinea-pig, sheep and pig, but with unsatisfactory results, and only after the injection of the generative organs of a monkey was a suggestive clue secured. Beyond this point, however, it was difficult to proceed; and only after the injection of a very large series of ovaries from individuals, ranging in age from a six-months foetus to a woman many years beyond the menopause, were final conclusions reached.

In the search for this normal scheme through an extensive number of serial sections, various questions directly dependent upon the circulation presented themselves for solution, which widened the scope of this work until it developed into a composite anatomical and physiological research.

Thus, the various vital phenomena have been considered which transpire within the follicle from its embryological origin and progressive growth to the time of its disappearance, either through an obliterative process or through its rupture, organization as a corpus luteum, and final retrogression as a corpus fibrosum. In this connection the author has advanced theories concerning the development of the ovary; the differential signs of sex; the descent of the ovary; the cause of ovulation; the synchronism of ovulation and menstruation; the mechanism of the rupture of the mature follicle, and the final cessation of ovulation; which have been based upon observations made in the study of a very large number of sections.

Soon after beginning this work he was struck not only with the difficulty of arriving at a definite knowledge of the scheme, but also of determining the age at which this scheme may be taken as a standard for comparison.

This is certainly not possible after active ovulation is established; for the constant changes in the vascular system, induced through the maturation, rupture and organization of the follicle, introduce an element of variability into the circulation of this organ which occurs in no other.

Failing to reach any satisfactory starting point in the adult, the author next studied the ovary of a girl approaching puberty, but with little more success, for it was found that almost as constant variations occur in the follicular circulation before as after the inauguration of ovulation. In the hope of finally reaching a period in the life of the female individual at which a definite standard for comparison might be found, numerous specimens from children of various ages were injected and closely studied. Finally, the ovary of a six-months foetus was obtained, which furnished a definite clue to the arrangement of the vessels; but as the follicular apparatus was still in process of development, a new-born child in which the tunica albuginea was well formed was selected as the standard. Even here the solution of the question was not easy, for in

order to trace the ramifications of the vessels from the point of their entrance into the ovary to their ultimate termination, a study of the serial sections of many ovaries was necessary.

XXVI.

The Gonococcus. A Report of Successful Cultivations from Cases of Arthritis, Subcutaneous Abscess, Acute and Chronic Cystitis, Pyonephrosis and Peritonitis. By H. H. YOUNG, M. D., Instructor in Genito-Urinary Diseases, The Johns Hopkins University. (Pages 677 to 707.)

This report represents a study of unusual infections of the gonococcus occurring at The Johns Hopkins Hospital during the past four years.

Gonorrhoeal arthritis is first considered, and a complete tabulation is given of ten cases in which pure cultures of the gonococcus have been obtained from diseased joints.

Five cases of subcutaneous abscesses due to the gonococcus are presented, together with a careful review of the literature showing the great rarity of such cases.

A case of general suppurative peritonitis, in which the gonococcus alone was grown from the peritoneal exudate, being the only case on record, is detailed.

In the discussion of gonococcus cystitis, a review of the literature shows that only two cases of acute cystitis in which the organism of Neisser was obtained in pure culture, and one case where by aspiration of the bladder pure cultures of the gonococcus were obtained from the urine, are recorded. In the others it was found on coverslip preparations.

A case of chronic alkaline cystitis of four years' duration due to the gonococcus alone, is presented as the first case in the literature, and the occurrence of a double pyonephrosis in the same case, due to the same organism, and likewise the first recorded instance, is mentioned.

The literature of kidney affections following gonorrhoea is reviewed at length, and a historical résumé of the successful demonstrations of the widespread infective powers of the gonococcus is appended.

XXVII.

The Histogenesis of the Cellular Elements of the Cerebral Cortex. By STEWART PATON, M. D., Assistant in Clinical Neurology, The Johns Hopkins University. With figures in the text. (Pages 709 to 741.)

XXVIII.

Experimental Pancreatitis. By SIMON FLEXNER, M. D., Professor of Pathology, University of Pennsylvania, Philadelphia. (Pages 743 to 771.)

The study upon which this paper is based consists of a series of experiments carried out upon dogs in which injections of acids, alkalies and other chemicals, as well as bacterial cultures, have been made into the duct of Wirsung and the interstitial tissue of the pancreas. By the several procedures employed, hemorrhagic, suppurative, necrotizing and chronic indurative pancreatitis have been produced. There has been frequently associated with these conditions fat-necrosis both in the peritoneal cavity and in the distant fat. The several forms of pancreatitis produced have been considered in their relation

pancreatitis in human beings. The histology of the lesions is so described and a comparison is drawn between the changes found in the experimental cases and those described in similar lesions in human beings. Attention has been paid to the use of fat-necroses with the determination that in all of them the fat-splitting ferment in quantities demonstrable by chemical test existed.

XXIX.

Chronic Hypertrophic Gastritis of Syphilitic Origin, Associated with Hyperplastic Stenosis of the Pylorus. By JOHN C. HEMMETER, M. D., Clinical Professor of Medicine, University of Maryland, and WM. ROYAL STOKES, M. D., City Bacteriologist, Baltimore. With 4 figures in the text. (Pages 773 to 794.)

The most important pathological changes noted in cases of chronic syphilis are ulceration, necrosis, and atrophy of the mucous membrane of the stomach, with a marked chronic interstitial increase of the connective tissue of the submucous coat. Large fibrous bands also extend into the muscular coat of the organ.

The case which the authors of this article report, gave a typical history of syphilis. The patient showed an absence of free and combined HCl, and pyloric stenosis was suspected. A surgical operation was performed for relief of the symptoms, and the patient died one month later.

An autopsy showed general infection with the bacillus pyomyositis and staphylococcus aureus, and the stomach was found shrunken to about one-third of its natural size. There was marked pyloric obstruction, without tumor or ulcer. The mucous coat was thickened and the mucous membrane unusually granular in appearance.

A microscopic examination showed atrophy of the glands of the mucous membrane, with the formation of villous-like projections, or diffuse formation of young fibrous tissue. The mucosa shows a marked thickening due to the presence of connective tissue with many areas of lymphoid cells, especially about the smaller veins.

This fibrous tissue extended to the muscular coat, and in places the peritoneum was thickened. The blood-vessels showed multiplication of the intimal cells but no other marked changes. These changes were more marked at the pylorus, and were apparent in sections taken from various portions of the organ.

The history of the case and the changes described justify the belief that the entire pathological process in the stomach was syphilitic in character.

XXX.

Case of Adenocarcinoma which Originated in the Submucous Glands of a Trachea-Like Formation, Found in a Sacral Teratoma. By WILLIAM H. HUDSON, M. D., La Fayette, Ala. With 2 plates. (Pages 795 to 804.)

A case of adenocarcinoma which developed from the submucous glands of a trachea-like formation found in a sacral teratoma is reported.

Among the foetal structures found in the teratoma were the trachea, the œsophagus, the posterior spinal ganglia, and other structures resembling normal physiological tissues.

The special interest in this communication centres in the malignant changes which were found to exist in the tumor. Reported cases of malignancy in teratomata are exceedingly rare, by far the largest number of such cases being of the epidermal type. The case here reported, and one other, are all the reported cases of teratomata in which malignancy has originated from glandular structure.

The surgery of teratomata is also considered, and the removal of these tumors is advised in every case, where such operations can be performed with safety to the patient.

XXXI.

On Hydromyelia in Its Relation to Spina Bifida and Cranioschisis. By E. BATES BLOCK, M. D. With 3 plates. (Pages 805 to 858.)

XXXII.

Experimental, Disseminated Fat-Necrosis. By EUGENE L. OPIE, M. D., Assistant in Pathology, The Johns Hopkins University, Baltimore. With 1 plate. (Pages 859 to 876.)

The relation of fat-necrosis to lesions of the pancreas was studied experimentally in cats. If the outflow of pancreatic secretion is completely obstructed by ligating both pancreatic ducts, foci of fat-necrosis are produced and may be widely disseminated. In two instances, in which the animals lived twenty-five and twenty days after the operation, almost the entire abdominal fat was opaque-white and necrotic, and foci of necrosis were found in the subcutaneous and pericardial fat. The presence of a fat-splitting ferment was demonstrated in the necrotic fat. In other instances, in which the animals lived a shorter time, less extensive necrosis resulted. Assuming that after duct-ligation a gradual diffusion of pancreatic juice or of the fat-splitting ferment occurs, the attempt was made to hasten the diffusion by stimulating, after ligation of the ducts, the secreting activity of the gland with pilocarpin. After the death of the animal extensive necrosis of the abdominal fat with foci in the pericardium was found. To test the ability of the fully formed pancreatic juice to cause necrosis of fat the duodenal end of the organ was transplanted in such a way that the secretion was poured into the subcutaneous tissue of the abdominal wall; typical fat necrosis resulted.

The condition essential to the production of focal fat-necrosis is the penetration of the fat-splitting ferment of the pancreas into living fat, and the lesions of the pancreas associated with fat-necrosis are such as permit this diffusion into the surrounding tissue. The widespread necrosis occasionally observed in man and in animals may be reproduced experimentally by conditions which favor diffusion of the ferment.

XXXIII.

Multiple Hyperplastic Gastric Nodules Associated with Nodular Gastric Tuberculosis. By CLARIBEL CONE, M. D., Professor of Pathology, Woman's Medical College, Baltimore. (Pages 877 to 890.)

The report is of a case of tuberculosis of the stomach occurring in the course of a general miliary tuberculosis, which came to autopsy in the pathological laboratory of The Johns

Hopkins Hospital in October, 1898. Besides the tuberculous infection of the stomach, gastric lesions of unusual character were also found.

From the surface of the stomach projected numerous small granules and occasional larger rounded nodules, varying in size from that of a pin-head to that of a pea.

Upon microscopic examination these nodules presented several histological types. There were (1) nodules due to connective-tissue overgrowth or to irregular fibrous contraction; (2) atypical glandular nodules; (3) nodules specifically tuberculous.

The connective-tissue nodules are doubtless a feature of chronic gastritis which was present. The atypical glandular nodules possess in part the features of a neoplasm; in part, the features of a simple hyperplastic growth.

Glandular hyperplasia seems more probable because there are present in the same mucous membrane simple proliferating gastric tubules, irregular groups of two, three or more tubules, larger irregular collections, and the circumscribed nodules themselves, all having a similar general structure, and all, no doubt, an expression of the same pathologic process.

The tuberculous nature of some of the nodules has been shown beyond question by both the histologic and the bacteriologic examination.

Between the tubercles and the hyperplastic glandular nodules no direct relation can be traced.

XXXIV.

On Serum Substitutes with Special Reference to Asiatic Cholera. By ARTHUR BLACHSTEIN, B. A., M. D. (Pages 891 to 901.)

XXXV.

Endocarditis Due to a Minute Organism, Probably the Bacillus Influenzæ. By MABEL F. AUSTIN, Baltimore. (Pages 903 to 911.)

In three cases of endocarditis which have come to autopsy, a minute bacillus was found which differs from any of the bacteria previously described as the cause of the disease.

The bacillus is identical in its peculiar morphological characteristics with the *B. influenzae* of Pfeiffer. Cultures were not obtained. The organism is very minute. It stains with the basic anilin dyes, but rarely uniformly; usually the poles of the bacillus take the stain more intensely, giving the appearance of a diplococcus. When treated by Gram's method the bacillus is readily decolorized. Great numbers of the organisms were found in the coverslip preparations made from the diseased valves, and in sections of the recent vegetations, and in one case clumps of bacilli were found also in the lung alveoli. No other micro-organisms were present.

While the failure to obtain cultures forbids definite conclusions as to the nature of the organism, it seems very probable from the evidence obtained that the bacillus is the *Bacillus influenzae*. This is of especial interest in connection with the many clinical reports of endocarditis occurring as a complication of influenza. The clinical histories of the three cases are given with the histological and bacteriological studies of the tissues obtained at autopsy. A brief review of the literature bearing on the subject is presented.

XXXVI.

On a Case of Chronic Nephritis Terminating with Symptoms of Landry's Paralysis. By LEWELLYS F. BARKER, Associate Professor of Pathology, The Johns Hopkins University. (Pages 913 to 923.)

The paper records a case of chronic diffuse nephritis which for two weeks before death presented the symptoms of ascending paralysis. At autopsy there were small red granular kidneys; an acute terminal hæmorrhagic colitis due to *Streptococcus pyogenes* was present. The microscopic examination of the spinal cord and brain revealed lesions in the nerve cells and in the blood-vessels. The lumbar cord was not affected, but there were alterations as high as the cerebral cortex. Not only were the motor-cells involved but alterations were also met with in the nerve-cells of the nuclei of the dorsal funiculi in the medulla oblongata.

XXXVII.

Model of the Medulla, Pons and Midbrain of a New-Born Babe. By FLORENCE R. SABIN, Baltimore. With 3 plates and 52 figures in the text. (Pages 925 to 1045.)

The article contains a description of a model of the medulla, pons and midbrain of a new-born babe made after the wax-plate method of Born. It was prepared from a series of horizontal sections stained by the method of Weigert-Pal, and reproduces in three dimensions, the various structures of the region so magnified that they can be seen and easily handled. The model, moreover, can be taken apart completely.

The model illustrates the form and position of each tract, the course of development being thereby suggested. The fact that the medial and lateral lemnisci which form the sensory tracts are closely related in form to the other structures while the pyramidal tract has but little or no influence in moulding the other parts, is emphasized.

The cerebral nerves and their nuclei are described and grouped according to their position and form, and these groups also illustrate the course of development. The most curious and interesting form, perhaps, met with in the model is that of the inferior olivary nucleus, its gyri and sulci being clearly indicated. The relation of the medulla oblongata to the spinal cord is also illustrated. The mode in which the white and gray matter continue into the medulla, the changes that undergo and the intrinsic structures of the medulla, pons and midbrain are in turn considered.

XXXVIII.

A Contribution to the Surgery of Foreign Bodies. By WILLIAM S. HALSTED, Professor of Surgery, The Johns Hopkins University. With 3 plates and 1 figure in the text. (Pages 1047 to 1059.)

DESCRIPTION OF THE JOHNS HOPKINS HOSPITAL.

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SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

THOMAS McCRAE, M. B. Spleno-Myelogenous Leukæmia; with Disappearance of the Spleen Tumor and of the Myelocytes from the Blood.—*The British Medical Journal*, March 31, 1900.

The patient, whose case is reported, came under observation twice in one year, with typical signs of spleno-myelogenous leukæmia. On each occasion the spleen tumor gradually disappeared, the leucocytes returned to normal and the myelocytes disappeared. He ultimately died, apparently of cerebral hæmorrhage. No similar case was found in the literature, although instances of disappearance of one of these conditions named are not uncommon.

HUGH H. YOUNG, M. D. The Present Status of the Appendicitis Question, as Shown by the Recent Literature and Society Transactions of France, Germany, England, and the United States.—*Maryland Medical Journal*, April, 1900.

THOMAS R. BROWN, M. D. Progress in Pediatrics.—*Maryland Medical Journal*, April, 1900.

ANDREW H. WHITRIDGE, M. D. Can Beginning Pulmonary Tuberculosis be Diagnosed Through a Shirt?—*The Medical Examiner and General Practitioner*, April, 1900.

MUNTER ROBB, M. D. A Clinical and Pathological Report of Two Cases of Genital Tuberculosis.—*Cleveland Medical Gazette*, March, 1900.

THOMAS R. BROWN, M. D. Cystitis due to the Typhoid Bacillus Introduced by Catheter in a Patient not Having Typhoid Fever.—*Medical Record*, March 10, 1900.

JOHN G. CLARK. Two Cases of Extranterine Pregnancy.—*American Journal of Obstetrics*, April, 1900.

HENRY C. COE, M. D. Pain as a Pathognomonic Symptom of Ectopic Pregnancy.—*Medical News*, April 21, 1900.

WILLIAM OSLER, M. D., and THOMAS McCRAE, M. B. (Tor.). Cancer of the Stomach in the Young.—*New York Medical Journal*, April 21, 1900.

SIMON FLEXNER, M. D., and LEWELLYS F. BARKER, M. D. Prevalent Diseases in the Philippines.—*Science*, April 6, 1900.

T. CASPAR GILCHRIST. Two Unusual Cases of Annular Syphilides in Negroes.—*Maryland Medical Journal*, April, 1900.

THOMAS R. BROWN, M. D. Cystitis Caused by the Bacillus Pyocyanus. Progress in Medicine.—*Maryland Medical Journal*, May, 1900.

HARRY T. MARSHALL, M. D. A Study of Christian Science.—*Md. Med. Jour.*, May, 1900.

H. O. REIK, M. D. Some Interesting Cases of Mastoiditis.—*Md. Med. Jour.*, May, 1900.

ROBERT REULING, M. D. Pathology and Neurology.—*Md. Med. Jour.*, May, 1900.

HUGH H. YOUNG, M. D. Progress in Surgery.—*Md. Med. Jour.*, May, 1900.

NOTES ON NEW BOOKS.

Diseases of the Stomach. By JOHN C. HEMMETER, M. D., of Baltimore. (P. Blakiston's Son & Co. Philadelphia, 1900.)

This is the second edition of this work which originally appeared in 1897. To the first edition a number of illustrations and nearly a hundred pages have been added. The general plan of the work has not been changed. Among the new material the articles on Hypertrophic Stenosis of the Pylorus, Obstruction of the Orifices, and Hemorrhage from the Stomach are specially noticed. Recent work and literature have been carefully used. The bibliography is a very valuable feature of the book, but many readers would prefer to have fewer references inserted in the text. In using the book we have often found the lack of orderly arrangement rather a drawback. The exact whereabouts of all the points on a given subject are often found with difficulty. The work has been found very useful and we congratulate Dr. Hemmeter on his second edition.

Anatomy of the Brain. By RICHARD H. WHITEHEAD, M. D. (The F. A. Davis Company, 1900.)

This is a book of 96 pages which aims at giving a short and concise account of the anatomy of the brain without too many minor details. It is divided into four chapters dealing with the divisions, surface anatomy, the internal anatomy and the conducting tracts of the encephalon. The text is clear and the giving of the facts adopted by the German Anatomical Society in addition to those commonly used in this country is a helpful feature. The illustrations are good and are not too complicated. Altogether the book should be of great use especially to students, as it is probably the best short description of the brain that we have in English.

BOOKS RECEIVED.

Transactions of the College of Physicians of Philadelphia. Third series. Volume the Twenty-first. 1899. 8vo. XLVIII + 197 pages. Printed for the College. Philadelphia.

Proceedings of the Philadelphia County Medical Society. Vol. XX. Session of 1899. Joseph M. Spellissy, M. D., Editor. 1899. 8vo. XVIII + 368 pages. Printed for the Society, Philadelphia.

The British Guiana Medical Annual. Edited by J. F. S. Fowler, M. B. Eleventh year of issue. 1899. 8vo. 23 + XXXVII pages. Printed by Baldwin and Co., Georgetown, Demerara.

Injuries to the Eye in their Medico-legal Aspect. By S. Baudry, M. D. Translated from the Original by Alfred James Ostheimer, Jr., M. D. Revised and Edited by Charles A. Oliver, A. M., M. D. With an Adaptation of the Medico-legal Chapter to the Courts of the United States of America, by Charles Sinkler, Esq. 1900. 12mo. X + 161 pages. The F. A. Davis Co., Philadelphia, New York, Chicago.

The Medical Annual and Practitioner's Index. Eighteenth volume. 1900. 12mo. LXXX + 871 pages. John Wright & Co.

The Pathology and Surgical Treatment of Tumors. M. D., LL. D. Second edition, revised and enlarged. With 12 engravings, and 12 full-page plates in color. W. B. Saunders, Philadelphia.

Essentials of Diagnosis. Arranged in the form of Questions and Answers. Prepared especially for the use of students. (Saunders' Question-Compendium.) Cohen, M. D., and Augustus A. Cohen. revised and enlarged. Illustrated. W. B. Saunders, Philadelphia.

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An Experimental Study of the Thyroid Gland of Dogs, with especial consideration of Hypertrophy of this Gland. By W. S. HALSTED, M. D.

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BULLETIN

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ON THE PRESENT STATUS OF THERAPY AND ITS FUTURE.*

BY LEWELLYS F. BARKER, M. B., *Tor.*,

Associate Professor of Pathology, Johns Hopkins University.

The only means we have of judging what the future has in store is to review the history of the past and to view accurately the present tendency or drift. The history of therapy is the history of medicine, for medicine began with therapy. It is not my purpose in the time allotted to me to undertake a recital of this history; I shall have to be content simply with an enumeration of epochs and perhaps a hint at the periods of progress.

Historians are gradually collecting for us the data concerning the earliest therapeutic efforts. The history of the earliest medicine shows of what a jumble these efforts consisted. With the dawn of intelligence the sympathy which was gradually evolved through the sense of pain led the primitive man to attempt to relieve the pain of his fellows. You recall the lines of a literary medical man:

"The hunt is o'er; the stone-armed spears have won;
Dead on the hillside lies the mastodon.
Unmoved the warriors their wounded leave;
The world is young and has not learned to grieve.

But one, a gentler sharer of the fray,
Waits in the twilight of the western day,
Where 'neath his gaze a cave-man, hairy, grim,
Groans out the anguish of his mangled limb.
Caught in the net of thought the watcher kneels,
With tender doubt the tortured member feels,
And, first of men a healing thought to know,
He finds his hand can check the life-blood's flow."

Disease is as old as man—it is only the knowledge of disease that is recent. In the fiercer physical struggle for existence which must have characterized the life of our primitive forefathers, external wounds and mangleings, as well as physical injuries due to exposure to the weather, to extremes of cold and heat, must have been common. Crude surgical procedures evolved by herdsman or shepherd began to be applied to man. The diseases peculiar to the female sex were first treated by the wise old women who had lived through the mysteries of the life of that sex. Of the nature of disease in general and particular the ghost of a true idea did not exist. Obscure diseases were regarded as instances of demoniacal possession. Prayers, chants and sacrifices to healing gods were universal. Devils were exorcised chiefly through the medium of priests. The priestly art and that

* Address in medicine delivered before the Ontario Medical Association, Toronto, June 6th, 1900.

of the physician were often combined. In China, in India, in Chaldea, in Egypt, the development of early medicine followed the same fundamental principles, though each country manifested special peculiarities.

The medicine of the Greeks interests us as much as any. Philosophers all, with an intense longing for the good, the true and the beautiful, they have left behind them records which in many respects make modest even the reader of to-day. In Heraclitus, Democritus and Empedocles and, above all, in Hippocrates we meet with much that is practically good in modern medicine and philosophy, especially as concerns the individual life, the ideal development of the personality. Though infants in anatomy and physiology and almost entirely ignorant of the nature of specific diseases, the Greek physicians had accumulated an account of symptoms and conditions and a therapeutic armamentarium that surprises the modern who for the first time reads his Hippocrates. The treatment of fractures and dislocations, the trepanning of the skull, the tapping of the abdomen and chest, the mode of dealing with hernia show us how daring they were in surgical measures. Had they known how to control hæmorrhage, who can tell what operations these cool-headed Greeks might not have devised. They were far less happy in the more difficult field of internal medicine. Most of their ideas about internal diseases were wrong, but some of their descriptions of individual cases are magnificent. Concerning the therapy of internal diseases, Hippocrates had many sound principles, and described some good practice. He recognized the healing power of nature and urged his followers to aid and follow nature—"quo natura vergit, eo tendere oportet." In Hippocrates can be found the tenets of many of the famous schools which have followed him. The principle of "contraria contrariis" and that of "similia similibus" are both in his pages, but wiser than some who came after him he limited himself to neither. "According to its kind and the circumstances underlying it, a case must sometimes be treated by agents acting unlike the disease, sometimes, on the other hand, the treatment must be undertaken by agents acting similar to the disease. The reason for this lies in the weakness of the human organism." Perhaps the strongest part of the therapy of that day was in the emphasis laid upon diet, gymnastics, bathing and mode of life in general. Who but has read and appreciated the Charmides of Plato, that exquisite dialogue in which the principles of Greek temperance are embodied. For a long time after Hippocrates this personal hygiene was accentuated. The visits of young men to the temples of Æsculapius, there to be instructed as to how to live, were long continued. Walter Pater's appreciation of a visit of this sort described in Marius the Epicurean will be recalled by many of you.

In Galen's time theory and gross empiricism reigned supreme. The idea of the four elements, heat, cold, dryness and moisture influenced the giving of drugs. These elements in a sense corresponded to the four cardinal juices of the human body, blood, mucus, yellow bile and black bile. The

therapeutic ideas of Galen, like his medical ideas in general dominated medicine for a thousand years.

With the advent of Vesalius and the development of human anatomy one might have hoped for rapid improvement in therapy, but this improvement was not immediately forthcoming. Even Harvey's discovery of the circulation of the blood and Malpighi's studies of physiology and pathology were not immediately fruitful in a therapeutic way. Paracelsus alone stands out as a reformer in internal medicine and therapeutic effort. He bravely opposed the authority of Galen, recognized the fallacy of trusting to knowledge obtained from books and relied rather upon personal observation and experience. Analysis shows, however, that even Paracelsus did but little to advance the actual knowledge of therapy.

About this time there was a wide-spread awakening in the natural sciences. Descriptive natural science and systemization ruled the thought of the day. During the period which followed a series of medical systems developed, based upon one-sided theories and badly based generalizations; Haller's doctrine of irritability, Brown's doctrine of stimuli, Hahnemann's homoeopathy, Gall's phrenology, along with many other schools came at this period to their development.

Real progress in therapy dates from the time when natural science became an exact study. Rigidly accurate observation followed by mature reflection has led to experimentation. Medicine of this sort is only a century old. It was almost synchronous with the widening of chemical discovery and of the working out by physicists of the principles which underlie many natural phenomena which up to the time had been entirely obscure, that microscopic studies began to be prosecuted seriously. Histology developed with Bichat; the cell doctrine with Schleiden and Schwann, pupils of the celebrated Johannes Müller. The French and the Germans became enthusiastic for pathological anatomy. Rokitansky counted his autopsies by thousands. The older physicians like Sydenham and Boerhaave, found worthy successors in Louis, Schönlein, Traube, and Wunderlich.

Virchow's cellular pathology established an entirely new view-point whence disease-processes could be observed. Charles Darwin's work on the "Origin of Species," Herbert Spencer's philosophy and Huxley's researches in comparative anatomy stimulated investigators in all sciences to examine into the evolution of phenomena, to consider the order of events in organic processes. Enormous strides continued to be made in physics and chemistry, and the new facts discovered in these branches permitted of the development of physiology by Ernst Brücke, Carl Ludwig, Emil Du Bois Reymond, Helmholtz and Claude Bernard. Caspar Fr. Wolf, Karl von Baer, Balfour, and His unravelled the mysteries of embryonic development. Improvements in the microscope and in microscopic technique led to a deeper penetration into the mysteries of histology and microscopic anatomy, normal and abnormal, than the most enthusiastic could have hoped for a few years earlier. New instruments of all sorts were

vised. Auenbrugger's percussion and Laennec's auscultation revolutionized physical diagnosis. The ophthalmoscope, the laryngoscope and the speculum, had much to do with the establishment of the specialties of ophthalmology, laryngology and gynaecology.

In the fight against infectious diseases a great victory had been won in the discovery of vaccination by Edward Jenner. Later on Henle's ingenious speculations concerning the nature of contagious diseases set many great minds in motion. With Pasteur and Koch came illumination. The infectious agent in the majority of infectious diseases is now known, can be cultivated in pure culture and can be utilized in animal experiment.

Physiological and pathological chemistry have been unveiling the mysteries of the fluids and solids of the body; pharmacology and toxicology are investigating the influences of drugs and poisons upon these. The application of Lister's happy idea with regard to wound infection, aided by the American-born boon of anaesthesia and a bloodless technique, totally changed the aspects of surgery. Wound infection, if not entirely an event of the past, has been enormously reduced. The holiest places of the body are to-day invaded by the surgeon's knife; the abdomen, the thorax, the joint cavities and even the brain are frequently and fearlessly explored. The heart, the last organ of man to be made accessible to surgical treatment, can now be sutured with success.

But more time must not be spent in glancing at the past; it is necessary at once to look at the present and to divine, if possible, whither we are being led.

As a result of development along so many diverging lines the study of modern medicine is concerned with a field so large that he who glances over it, cannot fail to be appalled at its magnitude. No single intelligence can in these days be familiar with the details of growth in all its parts; no single individual can hope to work efficiently in more than one or two of its subdivisions. The complexity of the work demands a division of labor, and most is gained from the efforts of men who, familiar with the general trend of progress in the whole field, concentrate their activities upon some one corner of it. Individual workers in the special medical sciences are pushing their investigations at the moment with devoted zeal. Anatomists are ever devising new technical methods; the cells formerly believed to be very simple "elements" are found to be highly complex organisms; parts of the body as, for example, the nervous system, are having their cellular nature for the first time revealed; the structural details of the intrinsic mechanisms of individual cells is in process of demonstration; the relations of the basis in one cell to that in other cells are being found out. Physiology, so long interested in the hydraulic principles of the circulatory apparatus and the muscle-nerve preparation, is being diverted to new channels of research, utilizing in its experiments the newly discovered principles underlying chemical and physical phenomena. The oxygenating and reducing processes which occur in the body, the various stages of anabolic and cata-

bolic metabolism, the phenomena of secretion and excretion, the interrelations of the various bodily activities, the functions of the different neural complexes, the mechanisms of defence and adaptation—these are some of the subjects with which physiologists are now busying themselves.

In pathological anatomy and physiology just as strenuous efforts are being made as in the other fundamental departments. Our ideas concerning inflammation have been so much modified that we are advised by some of the ablest pathologists to give up the term altogether. The nature of inflammatory exudates is still under discussion; what elements are of hæmic and what of local origin are disputed; the great cleft between the acute inflammations and the chronic processes associated with production of new connective tissue is still unsatisfactorily bridged. The ætiology of tumors, as yet unsolved, stimulates the embryologist on the one hand and the parasitologist on the other to renewed exertion. New tumors are being discovered; old ones are being regrouped; finer and finer distinctions between benignancy and malignancy are being drawn with results eminently satisfactory for the practical surgeon.

The therapeutic hopelessness that pathological anatomy inspires is more than compensated for by the faith in the future of therapy and prophylaxis directly derivable from a consideration of the teachings of pathogenesis. As pathological processes are traced further and further back to the earliest stages when function begins its deviation from the normal and the causes underlying those deviations gradually become recognizable the means of prevention and the indications for treatment become obvious.

Bacteriology appears to have done for us the greatest work of which it is directly capable; further advances in a similar direction promise to be made rather through the aid of chemistry and physics. The study of protozoan invasions is yet in its infancy and may have surprises in store for us. One cannot help but feel that we are on the brink of the discovery of the infectious agent in syphilis and the infectious fevers, but who can prophesy what the nature of the agent will be—animal, vegetable or less highly organized "ferment."

We have some reason to be proud of the present status of public hygiene. There never was a time when the general public was more industriously educated concerning the importance of hygienic measures than at present—never a time when the laity was more thoroughly exercised over this topic. Sanitary associations are innumerable; public health departments are everywhere demanded. Meat, milk and vegetables are inspected; impurities in food and drink are more and more excluded through the vigilance of the law. Contagious diseases are diagnosed early and isolated by city officials. Governmental sanatoria are in sight. Quarantine and disinfectant measures are more rigidly and fortunately more intelligently employed than ever before. Great epidemics are being choked at their starting places, the only mode in which they can satisfactorily be combatted. A fire can be extinguished by a fire department in its incipient stage—once well

under way it is beyond the control of human interference. There is good prospect that ere long the world will be through with those tremendous outbreaks of contagious disease of bacterial origin which from time to time have so devastatingly swept over both Western and Eastern civilizations. Thanks largely to Anglo-Saxon enterprise the back yards of the world in which the embers of epidemics smoulder are being rapidly cleaned up; this together with the rendering ever more infection-proof of the materials to which the flame of infection spreads bids fair to make the whole subject if not entirely, at least largely, a matter of history.

The present position of personal hygiene is a subject upon which we have less reason to congratulate ourselves. In principle we know much, in practice we do but little. Concerning climate, fresh air, diet, clothing, bathing, work, rest and recreation there is perhaps less dearth of information than negligence and inattention in performance. We behave hygienically when we are forced to do so, but not as a well planned order of life. Above all on this continent we have as yet to learn how to live and the problem here is less simple than elsewhere, for life here, especially in the great centres, is life at its most complex. Nowhere else is the strain so great—nowhere else does it so rapidly increase in tension. It must be a nervous system other than that which has been and that which is that will stand it. That nervous system may be now evolving, but in the meantime the unfit are succumbing in numbers ever more alarming. Moderation in all things and elimination of the non-essential from our lives would do much to tide us as a race over the transition period.

Perhaps the most significant movement at present observable in medicine is the beginning of the application of the newer ideas of physics and chemistry to the solution of biological questions. One has ever to be on his guard lest he expect too much from the introduction of new methods of approaching problems, but in this instance the principles underlying are so fundamentally important and have already worked such marvelous transformations in the mode of thought and activity of chemists that we are justified in expressing great hope for the future in their use by medical investigators. The doctrines of van't Hoff and Arrhenius are pregnant with great possibilities. van't Hoff's brilliant generalizations with regard to the behavior of solutions are found to hold good by a whole series of workers—the laws of osmotic pressure appear to be strictly analogous to the laws of Boyle, Gay-Lussac and Avogadro concerning gases. The theory of the dissociation of electrolytes—salts, acids and bases—into their components, the ions (cations and anions), which we owe to Arrhenius, affords a satisfactory explanation of an enormous number of facts hitherto unintelligible. These newer doctrines not only correlate facts hitherto unconnected, but they have shown the way to new lines of experimentation and have acted as a most powerful stimulus to original research. While it is probably not true that chemical activity is due solely to ions and never to whole molecules, yet the number of chemical reactions which according to the physical chemists are purely

ionic is very great, including certainly the majority thus far investigated. The studies of Kahlenberg and True on the toxic effects of acids and bases on plant life indicate that it is the hydrogen ion of the acid and the hydroxyl ion of the bases which is the active constituent. The significant experiments of Loeb on the power of muscle to absorb water in the presence of acids suggest the value of the physical-chemical method of thought in physiology. The work of Krönig and Paul upon the effects of disinfectant substances has made probable the ionic nature of this influence. The introduction by Dreser of the conception of the osmotic work done by the kidney and a calculation of the same in foot pounds of the deepest interest, even if his interpretation of his results, as it would appear, has to be somewhat modified. The practical results in sight from the clinical studies by the methods of physical chemistry undertaken by Hamburger, Köppler, Koranyi and others are being thankfully received by clinicians all over the world. Loeb of Chicago has recently interested us by proving the poisonous effects of pure solutions of common salt, and though his experiments have been upon low organisms, I should consider the medical man rash who continued to give a patient of low vitality large doses of ordinary salt solution when he can just as well introduce a solution in which the holding in a variety of salts corresponds more nearly to that of normal serum. Almost startling, too, is the assertion of Loeb that the eggs of echinoderms can be fertilized in the absence of spermatozoa by magnesium ions. In the phenomenon of fertilization—that *sanctum sanctorum* of physiological processes begins to be invaded by physical chemistry—what may we not expect from that science in the future. It would take too long to refer to other work in the field—to the constant reciprocal relation existing between chlorides and achlorides of the blood and urine, to the new ideas on the occurrence of œdema, to the speculations concerning so-called ion-proteids. Suffice it to say, that the promise for the future in pathogenesis and in pharmacodynamics is much brightened by the advent of physical chemistry. Were a medical student, suited by heredity and environment to look forward to the higher things in medicine, to ask me the question, "How can I best fit myself to make real advances in knowledge in medicine and therapy during the next twenty-five years?" I should say, "In addition to a thorough medical course, arm yourself with sufficient mathematics and gain a thorough theoretical and practical training in the methods of physics and chemistry and especially in the principles and methods of what is called 'physical chemistry.' After this turn your attention to the solution of medical problems." Not that the doctrines of van't Hoff and Arrhenius will be able to clear up all difficulties—the doctrines themselves may even be found to be only helpful hypotheses and later be supplanted by others less faulty,* but all our knowledge is but relative, and at present new know-

* Some physicists are inclined to believe that the "corpuscular" doctrine advanced by J. J. Thomson seriously threatens the position of the ion-conception.

edge can probably be easiest reached by working with the methods referred to.

The conviction is not infrequently expressed that surgery having gone so far cannot have many great conquests still before it, but when we review recent progress it would seem hazardous to deny the possibility of still more interesting advances. The extensive use of local anæsthesia since the introduction of cocaine in 1884 has led to striking modifications in surgical technique. The general narcosis produced by ether and chloroform together with perfected hæmostatic methods had a tendency to encourage slow operations. With cocaine anæsthesia and infiltration of the tissues with nearly indifferent fluids surgeons have again been compelled to operate more quickly and with greater efforts at precision. The discovery of the X ray has made bone surgery much more accurate work than it could ever have been before. Most noteworthy, perhaps, in modern surgery, are the operations which are now undertaken upon the liver, gall-bladder and bile ducts. These together with gastrointestinal surgery have elevated abdominal surgery to even a higher rank than that attained by pelvic surgery through the activity of the gynaecologists. Progress can certainly be expected still in the treatment of surgical diseases. Max Broedel in Kelly's service has just shown us by a study of its blood-vessels the best way to cut into the pelvis of the kidney.

The sharp line between medicine and surgery is breaking down. The two domains overlap at their boundaries and the importance of medical men and surgeons working together is becoming more and more appreciated. The establishment of a journal, the *Mittheilungen aus dem Grenzgebiete der Chirurgie und Medizin*, is an indication of the feeling which exists. The surgery of the future aside from emergency cases will be largely done in hospitals. Surgeons, to attain the necessary technical skill and familiarity with normal and pathological living tissues, must stand for years over an operating table. A trained corps of assistants and nurses is essential for the more difficult problems which now fall to the lot of the surgical specialist.

Compared with the brilliant achievements of the surgeon the therapeutic efforts of the physician are felt by most medical men as well as by the laity to be somewhat disappointing. In spite of the extraordinary keenness of diagnostic power which has been developed in internal medicine the painfully slow studies in pathological histology and in physiological and pathological chemistry, the wide-spread activity in pharmacological and pharmacodynamical experiment and the inimitable efforts of the manufacturing chemist to supply new drugs, the view is prevalent and rightly so that in the treatment of internal diseases "we have more to hope for the future than to entrust to the present." The explanation is obvious. The age is one of doubt. Authority now less than before counts for anything. There is a lively fear of empiricism, an insatiable desire for rational explanation. Physiological anatomy stimulated to brilliant diagnosis, but, at a time at least, it encouraged therapeutic pessimism.

Skoda, the type of a therapeutic nihilist even went so far as to say "we can diagnose disease, describe it and get a grasp of it, but we dare not expect by any means to cure it." In such a temper drugs of unknown physiological action cannot conscientiously be set to act upon bodily tissues in disease in which we are ignorant of the deviations from the normal of the chemical and physical processes going on in the cells. The death blow came first to polypharmacy; to-day, with many physicians, pharmacotherapy, as a whole, is almost moribund. Ask the prescription chemist how his work now compares with that of fifteen or twenty years ago. He will tell you that he is lucky if he fills ten recipes to-day, where he formerly filled a hundred. The druggist in the village or small town may still receive an occasional prescription which orders ten or fifteen varieties of herbs, but the fine old concoctions known to our fathers have almost entirely disappeared. It is seldom in this day that more than one or two drugs are prescribed at one time and these too often because "the patient must have something." A dozen drugs altogether suffice for the pharmacotherapeutic armamentarium of some of the most eminent physicians on this continent.

The reaction against the use of drugs, together with the development of the expectant method of treatment, permitted of a more accurate study of the natural cure of the disease than was before possible. Consistent homoeopaths who pushed their minimal dosage to such a degree that any conceivable drug effect was prevented did much, though unintentionally, to illustrate the healing power of nature unaided. Dietl's studies of pneumonia, treated without blood-letting, convinced him and the world that the effects of therapeutic interference in this disease had been greatly over-estimated.

Marked as have been the advantages derived from these therapeutic revolutions I cannot help but feel that the time has come for a more hopeful outlook for therapy in internal medicine. More thought among the best men might with advantage be given to it. Not that a whit less attention should be given to diagnosis or to pathological study—only through these is a successful therapy thinkable—but may we not interest ourselves more in the therapeutic measures of proven value which are really at our disposal. I am fully aware that some practitioners fail to properly diagnose their cases, that there are those who have but little scientific knowledge of disease, and it is these usually who possess the largest magazines of misplaced confidence in drugs. It may even be said to be certain that the majority of men in practice who leave it temporarily to undertake post-graduate work, would be benefited more by instruction in the wealth of diagnostic aids recently put at our disposal than by a course in therapeutics. That the skilled diagnostician, however, can be of greater service to his patients if he put the same keen, well-directed intelligence into motion with regard to treatment that he uses in diagnosis instead of stopping short at the diagnosis and shrugging his shoulders when therapeutic effort is mentioned, must be patent. As Leyden puts it: "The task of therapy is to help the patient as far as is possible with the

means at its disposal at the time; it dare not postpone the treatment to future discoveries. Specific therapy, long looked upon as that alone which is safe and worth striving for, is deprived of its absolute dominion; instead of 'curing diseases,' our task is altered to 'making patients well.'"

I cannot help but think that one of the causes of therapeutic pessimism among the better men in the profession lies in the fact that when therapeutics is spoken of most men call pharmacotherapy disproportionately into mind. It is because they are insufficiently known and appreciated that dietotherapy, climatotherapy, hydrotherapy, kinesiotherapy, electrotherapy and psychotherapy are not ranked with pharmacotherapy, and yet, in the majority of cases with which physicians deal, one or more of these is of far greater importance than treatment with drugs. Psychotherapy especially has a great future. Not until physicians become better psychologists and learn better how to apply psychic methods in the treatment of disease can we hope for the disappearance of such psychic epidemics as that represented by Christian science. In the near future psychopathogenic mechanisms should be carefully studied in order that psychoprophylaxis can have a wider field.

What the future of pharmacotherapy will be who will be rash enough to judge? That it will be great seems certain. That it cannot soon be great seems sure. Synthetic chemistry has supplied us with a host of new bodies for experimentation. Only a very small percentage of these have thus far been found to be of value. Antipyretics, analgesics and hypnotics especially are being multiplied. They have to be slowly tested on animals, then on healthy human beings and last of all on human beings in diseased conditions before their actual value can be ascertained. The effects of drugs like acetone-chloroform and urethane astonish us, however, and whet the appetite for further discovery.

No single system of therapy is likely soon again to hold general sway. *Contraria contrariis* and *similia similibus* have ceased among scientifically cultivated men to be a universal guide of therapeutic action. The biologically fundamental principle of Pflüger and Arndt, namely, that "minute stimuli, excite to vital activity, stimuli of medium strength favor it, strong stimuli inhibit it, strongest abolish it, it being, however, always an individual matter whether a given stimulus will prove to be feeble or one of medium strength or maximal," associated with the Ritter-Valli law that "diseased organs are in a state of heightened excitability" has been made by Oscar Schulz the basis of his "organ-therapy." Very valuable as the concept appears to be, medical men, with a caution born of experience, will be loath to accept it or any other generalization as an all-sufficient maxim.

The revival of organotherapy or opotherapy, as the French designate it, is a marked feature of present treatment. One of the oldest methods, having been employed long before the Christian era, opotherapy began with an attempt to produce an aphrodisiac effect by administering the genital organs of the respective sex to the individual who desired stimulation.

It is rather curious that the present revival was inaugurated by Brown-Sequard, the composition of whose elixir vitae you know. Organotherapy has, however, this time a rational basis in the conception of an internal secretion, deduced by Brown-Sequard from the studies of Claude Bernard. The production of experimental cachexia thyreopriva and the bringing of the proof that the transplanted thyroid would save an animal from the disease suggested the possibility of the use of thyroid substance in myxœdema and cretinism with the marvellous results which most practitioners have by this time been permitted to observe. The chemical analyses of Barmann showed that an iodine compound in the normal thyroid is an important element in the gland.

This "*Parenchymasaftherapie*," as Virchow designates it, obviously a substitution-therapy—a restoration to the diseased body of chemical substances, the removal of which from the normal body gives rise to symptoms of disease. It is in atrophic conditions of the gland that the therapy is valuable. Myxœdema and cretinism are diseases which correspond to the "altruistic atrophy" of Hansemann, while Basedow's disease is thought by many to be an example of "altruistic hypertrophy." Had the principles underlying thyroid therapy been earlier recognized we should not have expected benefit from the administration of thyroid extract in hypertrophic conditions of the gland.

The French are busy testing the effects of thyroid-therapy on the healing of fractured bones. The experimentation is still in progress and it is too early yet to say much regarding it.

Ponfick's remarkable case, which makes it appear possible that the hypophysis and the thyroid may be compensatory glands, will doubtless stimulate to further study.

With the advent of a successful thyroid therapy, to the notoriety hunters soon introduced organic extracts of the many various sorts. Cardin, cerebrin, hepatin were launched and vaunted. Examination of the manufacture of a certain prostate extract showed that it was being prepared from female animals! Such empirical attempts were worse than useless. They represent a return to the primitive.

With certain of the organs we are, however, provided with a rational basis for experimentation. Mering and Minkowski proved the disastrous effects upon the animal of extirpation of the pancreas. The diabetes which followed extirpation could be prevented by transplantation of pieces of pancreas. Yet for reasons not satisfactorily understood pancreas therapy has not been made practically useful.

Again, the effects of removal of the adrenals have been carefully studied. Addison's disease is believed to be largely the result of loss of adrenal substance. Unfortunately, administration of adrenal extract, while it may alleviate some of the symptoms of Addison's disease, has no effect on the others. The attention paid to the adrenal of late by physiological chemists has, however, been most fruitful. The studies concerning the blood-pressure raising constituents are extremely valuable. The active substance has been isolated

its chemical nature studied. The work of Abel and others upon epinephrin is furnishing most interesting data for future use.

Rhinologists are using adrenal extract as a vaso-constrictor in the nose. Fresh from the German press comes a careful report by Stoelzner (in Heubner's clinic), detailing a large number of cases of rickets, markedly benefited by adrenal extract. He finds that the cranio-tabes, the sweats, the delayed eruption of the teeth, the irritability of the vaso-motor system, the general restlessness and excitability, the curious smell of the urine, are all very markedly improved by the treatment. The softening of the thorax is frequently benefited. The inflammation of the glottis and other symptoms of tetany, however, usually appear to remain uninfluenced by the adrenal extract. The improvement can frequently be made out during the first week of treatment. An amelioration of the symptoms goes on rapidly for a few weeks, later on more slowly.

The spleen and bone-marrow extracts which have been shown to increase the white and red corpuscles of the blood, probably owing to the nuclein which they contain. That the physalis extract is of no value in acromegaly would not be surprising, if acromegaly should turn out to be, as some investigators believe, rather an instance of "altruistic hypertrophy" in the sense of Hansemann than one of "altruistic atrophy."

One of the most recent advances claimed in opotherapy is the feeding of ovarian substance as a substitution-therapy in (1) where the ovaries have been removed at operation, (2) at the climacteric to relieve the phenomena characteristic of that period. The substance is given in Germany in the form of Landau's oophorin tablets. Loewy and Richter state that this ovarian substance has a remarkable capacity for increasing the oxygenating power of the body-cells in cases in which the ovaries have been removed. Their reports are very convincing. Whether or not the therapy will be useful in preventing the obesity so characteristic of so many such cases we must wait to see, but the Germans feel confident that it will.

The advances along the lines of opotherapy are sufficiently indicated by the foregoing experiences. Physiology, experimental pathology, physiological chemistry, pharmacology and aerodynamics must lead the way.

In the struggle against infectious diseases a rapid extension of the powers of the physician is observable. The resistance of human beings as a whole is being increased not only by the method of natural selection, but by a more rapid mode of personal hygiene. Prophylactic inoculations have been multiplied since the work of Pasteur. The cholera infection, that for pest and that for typhoid, appear to be controllable. Flexner in Philadelphia is now experimenting with prophylactic inoculation against the bacillus dysenteriae so deadly in outbreaks in the Philippine Islands and Japan. The introduction of Behring's serum-therapy in diphtheria has undoubtedly greatly reduced the mortality of that disease, indeed, diphtheria is now scarcely a disease to be dreaded. Aside

from the serum against diphtheria, however, there is as yet little of practical value to acknowledge from this side.

The antidiphtheric serum is an antitoxic serum. That introduced against-tetanus is also an antitoxic serum. To be ranked with these two is probably also Calmette's serum against snake poison. Tetanus serum is only preventive, not curative, possibly owing to the fact that the antitoxine injected subcutaneously or into the blood cannot reach the toxine when once the latter has combined with the protoplasm of the nerve cells. Even intracerebral introduction of the antitoxine is not fully satisfactory for obvious reasons. All the other sera which have been introduced, namely, those against cholera, the streptococcus, pneumococcus, the bacilli of plague, anthrax and typhoid fever are not antitoxic sera but antibacterial sera. They do not neutralize the poison which the bacteria produce but have the power of killing the bacteria in the body of the patient and of dissolving them up. Not a single one of these sera is as yet practically useful as a therapeutic measure.

Ehrlich's studies make it probable that with these antibacterial sera at least two bodies are necessary for successful action; (1) the *inter-body* or *immunizing body*, and (2) the *end-body* or *complement* (formerly called *addiment* by Ehrlich). The latter is present in normal serum and is the true dissolving body, but it can act only when it is bound to the bacterial cell by means of the immunizing body. The antibacterial sera are rich in the immunizing body. It may be possible that they are insufficient owing to there not being enough of the end-body present. Wassermann is now making experiments in this connection. He hopes that by increasing the amount of end-body or complement available that the antibacterial sera may be rendered valuable in the treatment of disease in human beings.

Had not this paper already become too long it would have been interesting to refer to the progress making in the treatment of conditions of auto-intoxication and of the so-called constitutional diseases, but I must forbear.

From what has been said it is obvious that we have no reason to be discouraged as regards the future of therapy, but rather cause for hope and enthusiasm. We have learned the secret of progress and some formulæ for daily action. The secret of advance lies in the consciousness of the fact that it is the orderly application of the well-trained intelligence to medical problems that alone yields valuable results—not the haphazard guess work of the ignorant and untrained mind. Prolonged technical education and systematic research lead to therapeutic advance. In daily life, in the application of discoveries already made, the quack and the routinist physician, with the healing power of Nature behind them, will cure many cases, but we can be sure that greater success and especially greater mental satisfaction will attend the efforts of the physician well educated in the various medical sciences who, thinking *all around and through his case*, arrives at the most accurate diagnosis possible and gives the patient the benefit of a well-planned conscientious treatment, utilizing every means

which will tend to his cure or relief. If this physician have a specific he will be glad to employ it; if radical cure be impossible he will not neglect the palliative; if at last the exitus

lethalis cannot be prevented he will at least see that the case is euthanasic.

A COMPARATIVE STUDY OF SOME MEMBERS OF A PATHOGENIC GROUP OF BACILLI OF THE HOG CHOLERA OR BAC. ENTERITIDIS (GÄRTNER) TYPE, INTERMEDIATE BETWEEN THE TYPHOID AND COLON GROUPS.

WITH THE REPORT OF A CASE RESEMBLING TYPHOID FEVER, IN WHICH THERE OCCURRED A POST-FEBRILE OSTEOMYELITIS DUE TO SUCH AN INTERMEDIATE BACILLUS.

BY HARVEY CUSHING, M. D.

(From the Laboratory for Surgical Pathology of The Johns Hopkins Hospital.)

The possibility that under varying conditions of environment different characteristics may be acquired by the members of the large typhoid-colon group of bacilli has inclined some investigators to regard them as closely related or even interchangeable organisms. Nevertheless, there are certain forms which possess, as ordinarily encountered, such definite cultural and pathogenic peculiarities, and which have a tendency to retain the same with such a degree of permanency, that they may be recognized as distinct and constant variations. That this applies to *B. typhosus* and *B. coli communis*, the extremes of the group, is too well known to be dwelt upon. There exists, however, intermediate to these forms, one especially recognizable subdivision, the clinical significance of which as a definite type has been much slighted.

The members of this particular intermediate group are bacilli which possess the morphological and motile properties of Eberth's bacillus but differ from this organism chiefly in the fermentation reactions, since they produce gas in the presence of glucose and other more easily fermentable carbohydrates. Their chief distinguishing feature from the bacillus of Escherich, on the other hand, rests upon the fact that fermentation in various media made from milk does not produce sufficient acidity to precipitate the casein, but, on the contrary, the acid production is but a transient process and is followed, in the presence of air, by a prompt (2-3 days) and distinguishing alkalization of the media which furnishes a ready means of differentiation from both the typhoid and colon type.

Herbert E. Durham,¹ in 1898, boldly divided this whole family into three groups as follows:

I. The Eberth group including *B. typhosus* and its near allies.

II. The Gärtner group including *B. enteritidis* and its near allies.

¹ Durham, Herbert E.: On the serum diagnosis of typhoid fever, with especial reference to the Bacillus of Gärtner and its allies. The Lancet, Vol. I, p. 154, January 15, 1898.

III. The Escherich group including *B. coli communis* and its near allies.

He states in parentheses that the "allies" of the typhoid group are almost unknown,* while those of groups II and III have never been sufficiently worked out.

In this intermediate or Gärtner group Durham has placed the following organisms: *Bac. enteritidis* of Gärtner,² *B. Bslaviensis* (von Ermenghem),³ *B. moribificans bovis* (Basenau), the "Wurstvergiftung" bacillus described by Fischer,⁴ *B. Friedebergensis* (Gaffky und Paak),⁵ the Cotta "Fleisch-

* Organisms culturally indistinguishable from *B. typhosus* have been encountered in the surgical laboratory on several occasions during the past two years. These have been obtained from a perirenal abscess, from the urinary bladder and from peritonitis infections of intestinal origin unassociated with typhoid; on one occasion from the lumen of a chronically inflamed appendix. Similar organisms have been met with in the alimentary canal of healthy dogs. We have hesitated to regard these as *B. typhosus* from the absence of a definite reaction with typhoid serum though they are doubtless closely related forms. From what I have seen of Shiga's bacillus dysenteriae, a specimen of which, obtained in the Philippines, was kindly given to me by Dr. Flexner, I should regard it also as an allied form of *B. typhosus*.

² Gärtner: Ueber die Fleischvergiftung in Frankenhäusern, Kyffhäuser und den Erreger derselben. Correspondenz-Blatt des Allgemeinen ärztlichen Vereins von Thüringen. No. 9, 1892.

³ Von Ermenghem: Recherches sur les empoisonnements produits par de la viande de veau à Morseele. Travaux du laboratoire d'Hygiène et de Bactériologie de l'Université de Gand. Tome I, fascicule 3, 1892.

⁴ Basenau, Fritz: Ueber eine im Fleisch gefundene infective Bacterie. (Bac. moribificans bovis.) Archiv für Hygiene. Band XX, S. 242, 1894, and XXXII, p. 219, 1898.

⁵ Fischer, Bernhard: Ueber einige bemerkenswerthe Befunde bei der Untersuchung choleraverdächtiger Materials. Deutsche medicinische Wochenschrift, Jahrg. XIX, S. 575-598, 1893.

⁶ Gaffky und Paak: Ein Beitrag zur Frage der sogenannten Wurst- und Fleischvergiftungen. Arbeiten aus den kaiserlichen Gesundheitsamte. Band VI, S. 159, 1890. Also Deutsche medicinische Wochenschrift, Jahrg. XVIII, S. 297, 1892.

"typhoid" bacillus,⁷ as well as the organisms described by Gunther,⁸ Karlinsky,⁹ Kaensche¹⁰ and others.

These bacilli, it will be seen, come almost uniformly from meat-poisoning epidemics which occurred on the continent, and presumably they are the identical organism which Gärtner first described in 1888.*

Durham further believes that the gas-producing "typhoid" bacilli of various observers almost certainly belong to this group as well, and not improbably also those cases of "septic typhoid fever" of French authors, in which death occurred before typical lesions had appeared and which were supposed to be due to Eberth's bacillus. In other words, there are possibly intermediate gas-producing forms of the typhoid-colon family which may be the cause of infections giving clinical symptoms easily mistaken for typhoid fever. This is of importance in relation to the cases which are to be described later.

Theobald Smith,¹¹ during his investigations concerning the bacteriology of infectious swine diseases in 1893, had noted great similarity between *B. cholerae suis* and a variety of

Die Fleischvergiftung in Cotta. 21 Jahresbericht über das Viehwesen im Königreich Sachsen auf das Jahr, 1889, S. 104. Hygienische Rundschau, 1891, S. 716.

Gunther, Carl: Bacteriologische Untersuchungen in einem Falle von Fleischvergiftung. Archiv für Hygiene, Bd. XXVIII, 1897, p. 46.

Karlinsky, Justyn: Zur Kenntniss des Bacillus Enteritidis (Gärtner). Centralblatt für Bacteriologie, Bd. VI, S. 289, 1889.

Kaensche, C.: Zur Kenntniss der Krankheitserreger bei Fleischvergiftungen. Zeitschrift für Hygiene, Bd. XXII, S. 53, 1895.

This was found under the following circumstances:

In Saxony a diseased cow had been slaughtered and the flesh used for food. Fifty-seven people who had eaten of this meat became ill, the severity of symptoms being directly proportional to the amount consumed and inversely to the thoroughness of cooking. One young working man ate 800 grams raw, and died in about 35 hours. Gärtner isolated from the flesh of the diseased cow and the organs of this fatal case his so-called *enteritidis*. Durham himself¹² has encountered the same organism in the liver of a fatal case from an epidemic in England, and he alone among English writers has concerned himself with these infections. In his valuable address¹³ given at Oldham in 1898 he lays especial stress upon the importance of *enteritidis* as the cause of the various meat-poisoning epidemics and describes his observations on the Chatterton outbreak.¹⁴

Smith, Theobald, and V. A. Moore: Additional investigations concerning infectious swine diseases. Bureau of Animal Industry, U. S. Department of Agriculture. Bulletin No. 6, p. 10, 1894.

Durham, Herbert E.: An epidemic of gastro-enteritis associated with the presence of a variety of the bacillus enteritidis (Gärtner). British Medical Journal, Vol. II, p. 600, Sept. 3, 1898.

Durham, Herbert E.: An address on the present knowledge of outbreaks due to meat poisoning. British Medical Journal, Vol. II, p. 1797, Dec. 17, 1898.

Howes and Ashton: An outbreak of Food Poisoning; being a report on 35 cases of veal-pie poisoning occurring in Chatterton. British Medical Journal, Vol. II, p. 1456, Nov. 5, 1898.

other pathogenic forms among which were Gärtner's *B. enteritidis*, Loeffler's *B. typhi murium*, a bacillus found in a mare after abortion, etc. He in consequence has since referred to them as members of the "Hog Cholera Group" of bacilli in much the same significance as Durham uses the term "Gärtner group." Unfortunately, however, owing to what seemed at the time (1885) an advisable change in terminology, the name hog cholera bacillus was given to an organism previously called swine plague bacillus and some misinterpretation has arisen abroad concerning the variety *B. cholerae suis* as it is now recognized in this country, from the confusion in nomenclature resultant to this change.*

Recent observations by Reed and Carroll¹⁵ have further demonstrated that there is a close biological relationship between Sanarelli's *Bacillus icteroides* and *B. cholerae suis* and through their report has occasioned much discussion,¹⁶ the former organism also doubtless belongs in the group under consideration. Some months previous to their published report, acting upon a suggestion of Dr. Welch, I had found that it was almost impossible to recognize any cultural differences between these organisms and bacilli of the *B. enteritidis* (Gärtner) type which I was studying.†

We thus see that the close biological relationship of many of these organisms has been recognized, though no attempt

* Kruse in 1896 (C. Flügge, Die Microorganismen, Zweiter Theil, S. 401) describes the present *B. chol. suis* of American writers under the name *Bacillus suipestifer*, which he places in the Hemorrhagic Septicæmia group.

¹⁵ Reed, Walter, and James Carroll: *Bacillus Icteroides* and *Bacillus Cholerae Suis*—a preliminary note. The Medical News, Vol. LXXIV, p. 513, April 29, 1899.

¹⁶ 1. Sanarelli, G.: Some Observations and Controversial Remarks on the Specific Cause of Yellow Fever. The Medical News, Vol. LXXV, p. 193. Aug. 12, 1899.

2. Sternberg, Geo. M.: The *Bacillus Icteroides* as the Cause of Yellow Fever. A Reply to Professor Sanarelli. Ibid. Aug. 19, 1899.

3. Reed and Carroll: The Specific Cause of Yellow Fever. A Reply to Dr. G. Sanarelli. Ibid. Sept. 9, 1899.

4. Novy, F. G.: The *Bacillus Icteroides*. A Reply to Dr. Sanarelli. Ibid. Sept. 23, 1899.

5. Sanarelli, G.: The Bacteriology of Yellow Fever once More. Ibid. Dec. 9, 1899.

† The culture of *B. icteroides* which was used had been originally obtained from Roux's laboratory and was but one removed from Sanarelli's original organism. Dr. Reed has since kindly furnished me with three varieties of *B. icteroides* obtained from Santiago and Havana. These organisms belong to the Gärtner group and possess no cultural characteristics sufficient to distinguish them from *B. enteritidis* or *B. cholerae suis*. Differences in pathogenic activity in man and animals and in the serum reactions doubtless exist just as do variations in pathogenicity among members of the *B. coli* group, and consequently to state that the hog cholera bacillus is culturally indistinguishable from *B. icteroides* does not seem to me necessarily to indicate that the latter may not be the cause of a specific infection (yellow fever). As will be seen in the experiments on pathogenic action, the serum test alone is a means of distinguishing members of the group and cultural similarities are by no means an indication of equalities in pathogenic virulence.

has been made to classify them on other grounds than variations of pathogenicity in which peculiarity the individual members of a species naturally differ within wide limits, which in no way affects phylogenetic relationship. The variability in nomenclature itself shows how little recognition has been paid to the similarity of cultural as well as of clinical and pathologic manifestations of the members of this intermediate group.

In 1897¹⁷ Widal described an organism which was isolated from an œsophageal abscess some years after an attack of typhoid fever, and adopting the nomenclature of Gilbert¹⁸ he designated it a "paracol" bacillus. With this organism he grouped several others having similar characteristics, as the bacillus psittacosis of Nocard and the "microbe de la septicémie des veaux" of Thomassen.¹⁹ From Widal's brief description it would seem that this organism is a member of the intermediate group under discussion. It was an actively motile bacillus producing no indol and fermenting glucose but not lactose. Widal's claim for specificity of this particular type was based on the definite serum reaction which the patient's blood showed toward the organism.

The terms paracol and paratyphoid, however, Durham does not consider at all appropriate, as the members of the group are quite distinct from both *B. typhosus* and *B. coli*.

Gwyn²⁰ in 1898 reported a remarkable case which occurred in Dr. Osler's clinic and which presented all of the clinical symptoms of typhoid fever, but in which no serum reaction was at any time demonstrable toward the *Bacillus typhosus*. From the blood of this patient Gwyn isolated in pure culture an organism having cultural characteristics akin to the Gärtner group, and which under the influence of Widal's terminology he designated as a "paracol." Toward this organism the patient's serum had an agglutinative reaction in further evidence of the infection. The failure on repeated examinations to demonstrate any serum reaction toward *B. typhosus* was of course not conclusive evidence of the absence of typhoid fever, but the query was naturally raised whether the clinical symptoms could not have been due entirely to an infection with the isolated "paracol" alone. Of the several hundred cases of typhoid fever which have occurred in Dr. Osler's service since the employment of the Widal-Gruber reaction has become a routine measure of confirming diagnosis, only a few individual cases have failed to show a definite agglutinative reaction toward *B. typhosus*. It is not impossible that these cases may have represented infections with members of the intermediate group. Durham mentions in his paper a personal experience with an infection resem-

bling a mild typhoid, after which he found a persisting ser reaction toward *B. enteritidis* and which he naturally acci ited to a presumable original infection with this bacillus.

A case recently entered the surgical wards (Dr. Halsted of The Johns Hopkins Hospital which furnishes the sub of this communication. An organism almost identical w that of Gwyn's and belonging to or closely allied to the I Cholera or Gärtner group was isolated from an abscess of rib which appeared during the convalescence from a p longed fever of enteric type. That a general infection occurred was clear from the specific action of the patie serum toward the isolated organism; there was no agglutina tive reaction whatever evidenced toward *B. typhosus*. Whether this infection was of intestinal origin and occur through the atrium afforded by typhoidal lesions or whet it was in itself the cause of the fever, must remain undecid though it seems from these two cases not impossible tha prolonged fever with the clinical picture of typhoid may induced by the members of this intermediate group. In there been a mixed infection, one would have expecte a double agglutinative reaction which was not present.

CLINICAL SUMMARY.

Typhoid fever (?) with relapse. Costochondral osteonecrosis during convalescence. Abscess with rupture six months later. Persisting sinus for three months, showing pure culture of intermediate bacillus at operation.

CASE. Surgical No. 8753. M. Burley, colored, aged 27, was admitted into Dr. Halsted's service, March 1st, 1899 with the following history: From early in June, 1898, in months before admission, he had suffered with a prolonged course of fever extending over a period of ten weeks. A note from his physician, Dr. Hammond, of Jessups, Maryland, describes the case as one of typhoid with a severe but typical clinical course. The history is without particular note except that he had a distinct relapse of the fever which was ushered in by a profuse hemorrhage from the nose. During his convalescence, the patient says that he had noticed two tender nodules near his breast bone, one the size of a dollar, the other somewhat smaller. The latter subsequently disappeared. The larger one increased in size and six months later broke open, evacuating a large amount of pus. Since that time it has continued to discharge, the sinus persisting without tendency to heal permanently, though it has closed on several occasions for a short period.

Examination showed the opening of a sinus, lined by granulations and discharging a small amount of pus, situated on a level with the fifth rib at the edge of the sternum. There were slight œdema of the surrounding tissues and tenderness for a few centimetres along the course of the fifth rib. A probe could be inserted for five centimetres downward and to the left about to the junction of the rib and cartilage where a grating bony substance could be felt.

The patient's physical examination was otherwise negative.

¹⁷ F. Widal: Séroréaction dans une infection à paracolibacille. La Semaine Médicale, 4 août, 1897.

¹⁸ Gilbert: De la Colibacillose. Semaine Médicale. 1895, p. 1-3.

¹⁹ Thomassen, M.: Une nouvelle septicémie des veaux. Annales de l'Institut Pasteur. Tome XI, p. 523, 1897.

²⁰ Gwyn, Norman B.: On Infection with a Paracol bacillus in a case with all the clinical features of typhoid fever. The Johns Hopkins Hospital Bulletin, Vol. IX, p. 54. March, 1898.

to clumping reaction could be demonstrated toward *B. typhosus* with the patient's serum.

Operation March 6th, 1899. The sinus and surrounding tissues, with a button of chest wall including the cartilage of the adjoining ribs were excised and the wound closed over a good clot by a plastic skin flap.

The tissues removed consisted of the cartilage and portion of bone of the diseased rib. A cavity measuring about one inch in diameter lined with pale granulation tissue was situated in the cartilage near the end of the bone. A sinus led from this through the cartilage toward the sternum. No bone formation could be demonstrated in this cartilage. The cartilages of the adjoining ribs (6th and 7th), portions of which were excised as described, showed marked evidence of beginning ossification as a fine network of new bone-formation preventing easy section with the knife.*

Cultures were taken at the operating table from the bottom of the sinus immediately on making the first incision into it. These cultures showed a pure growth of a bacillus which fermented glucose and did not coagulate milk. Appreciating the rarity in such situations of bacillary forms other than *typhosus*, the organism was carefully examined with the results to be appended, namely, its identification as a member of the intermediate, the Hog Cholera or Gärtner group. For convenience this bacillus will hereafter be called *Bacillus O*.

Agglutination reactions with the isolated organism.

The following early observations upon the agglutinative reactions of the patient's serum toward the isolated organism toward other members of the typhoid-colon family which were at hand, as well as a comparison with the reactions of serum obtained from other sources toward these same organisms were kindly made for me by Dr. Gwyn. Unfortunately, at the time the relation of *B. chol. suis* and *B. icteroides* with the organism in question was not recognized, and not until after I did I come into possession, through the courtesy of Dr.

It is noteworthy that postenteric and traumatic osteomyelitis in children almost invariably have their starting point at the epiphyseal ends of the long bones of the extremities, while only in adults do we find similar processes originating in the costochondral articulations. The natural explanation is to be that the seat of most active bone-formation is especially susceptible to infectious processes. In adults the cartilages of the ribs represent practically the only situation where ossification in cartilage is taking place. The occasional seat of post-typhoid infection in the thyroid cartilage of adults may be traced for in similar fashion. In a post-typhoid case operated upon two years ago at this hospital by Dr. Finney, I had an excellent opportunity of examining the tissues, since there had been no preformed sinus and the infected area with portions of the two neighboring ribs had been removed *in toto*. The abscess had apparently started in the cartilage of the sixth rib close to the rib itself, where ossification, as was seen by comparing sections of the cartilages of the adjoining ribs, had been in progress. A pure culture of *B. typhosus* in this case was obtained from the cavity in the cartilage.

Durham, of Gärtner's bacillus, *B. morbificans bovis* (Basenau) and the variety "Hatton" which Durham has described. When these organisms were received, three months after the operation, I found that the patient's serum had so far lost its reaction toward the intermediate bacilli that the results were unsatisfactory for comparative purposes and none of the original serum had been saved. This, however, was compensated for by comparing results with the serum obtained from an immunized animal, as will be described later.

(A) Effect of a variety of sera upon *Bacillus O*, the organism isolated from the abscess.

I. Reactions with patients' serum. Two observations with 10-hour cultures showing active motility. A marked immediate reaction* occurs in slight dilutions, with instant cessation of motion and the formation of large clumps, in $\frac{1}{2}$ to 2 minutes. Reaction is slower but distinctly marked in a 1-800 dilution in two hours.

II. Reactions with other agglutinating sera. Typhoid sera, A., B. and C., agglutinating *B. typhosus* in dilutions of 1-400. All were quite negative in dilutions of 1-10 in two hours. The motility in all cases was but slightly if at all affected.

III. Reactions with sera of healthy individuals. Five normal sera were tried in dilution of 1-10. The reaction was absolutely negative in all cases.

(B) Effect of the patient's serum upon other agglutinable organisms of the typhoid-colon group.

I. *Bacillus typhosus* reacting well to typhoid serum in dilutions of 1-200 and 1-300. Little or no effect upon motility in two hours in dilution of 1-10.

II. *B. coli communis*. Six varieties from stock cultures of the pathological laboratory.

A. Motility active.	Dilution	1-200	{ Well marked clump- ing. Motility not ab- solutely stopped in two hours.
B. Motility slight.	Dilution	1-50	
C. " very sluggish	"	1-10	{ Fair reaction in one hour.
D. " " " "	"	1-10	
E. " " " "	"	1-10	{ No appreciable effect in one hour.
F. " " " "	"	1-10	

III. *B. Paracolon* (Gwyn). Motility very active. Dilution 1-10. Slight evidence of reaction. Cessation of motility.

* For a reaction to be *positive* we understand that there must be a complete cessation of motility, with clearing of the field of individual organisms and the formation of large clumps. The figures may seem low, but "a reaction" is looked upon very critically.

(C) Comparison of the effect of the typhoid and normal sera used in (A), II and (A), III upon these same organisms of (B).

	Typhoid serum	Normal serum (a)	Normal serum (b)
B. typh.	1-300 Positive.	1-10 Negative.	1-10 Negative.
B. coli A.	1-100 Positive.	1-10 Positive.	1-10 Positive.
B. coli B.	1-50 Suggestive.	1-10 Suggestive.	1-10 Suggestive.
B. coli C.	1-10 Negative.	1-10 Suggestive.	1-10 Negative.
B. coli D.	1-10 Suggestive.	1-10 Positive.	1-10 Positive.
Paracolon (Gwyn)	1-10 Negative.	1-10 Negative.	1-10 Negative.

These results show the absence of any reaction on the part of the patient's serum toward *B. typhosus* or toward any other organism tried except an occasional variety of *B. coli*. It is, however, a not uncommon observation to find an agglutinative reaction toward colon, since sera from apparently healthy individuals, as the above results demonstrate, often react in some degree toward members of the colon group, doubtless from the more or less frequent slight colon infections which occur in the course of occasional mild enteritides. In the absence, therefore, of a double agglutinative reaction we may with propriety exclude the possibility that the infection with *Bac. O* was superimposed upon a typhoidal infection and that the former organism and not *B. typhosus* was responsible for the clinical symptoms.

Note on the Pathology and Bacteriology of the Lesion.

The isolation of this organism from an osteomyelitic process secondary to an enteritis and the positive agglutinative reaction of the patient's serum toward it are conclusive evidence of a peripheral septicæmia, such as frequently occurs during the progress of enteritides occasioned by *B. typhosus*. It is, of course, possible that many of these intermediate organisms may have their habitat at one time or another in the intestine and, through the atrium afforded by lesions such as occur in typhoidal enteritides, they may enter the portal circulation, or, indeed, by way of the thoracic duct, the peripheral circulation, provided they are not checked by the mesenteric glands. Thus a peripheral septicæmia, such as in typhoid fever frequently occurs from an invasion with the specific organism of the disease itself, may supposedly be occasioned by the entry of any intestinal bacterium. Such a secondary invasion Dr. Welch,²¹ in 1890, demonstrated to be possible with *B. coli*, but it has been a common observation that in such superimposed colon infections the organisms only exceptionally pass beyond the confines of the abdominal cavity.* It is therefore exceedingly unusual to find in peripheral post-typhoidal lesions organisms of *intestinal* origin

²¹ Welch, Wm. H.: The Bacillus Coli Communis; the Conditions of its Invasion of the Human Body, and its Pathogenic Properties. Medical News, Vol. LIX, p. 669, Dec. 12, 1891.

* This has been discussed in a recent paper.²²

²² Observations upon the Origin of Gall-Bladder Infections and upon the Experimental Formation of Gall Stones. The Johns Hopkins Bulletin, Vol. X, Nos. 101-102, p. 166, 1899.

other than the typhoid bacillus itself, though complicating pyogenic skin (coccal) organisms are common. The abdominal complications, occurring in the liver and gall-bladder, for example, by way of the portal circulation are, on the other hand, frequently due to such secondary invasion. For the reasons, as well as those given above, it seems unlikely that *Bac. O* was such a secondary invader. In suppurative sequelæ in bone especially, it has been exceptional, if we may draw conclusions from such lesions as have occurred secondary to typhoidal enteritides, to find intestinal bacilli other than the specific organism of the disease. As has been stated, the latter is frequently present in the peripheral circulation and as Quinke²³ has demonstrated, it finds the bone-marrow a habitat of especial predilection. Of the fifty-one cases of post-typhoidal bone lesions which Keen²⁴ collected, and in which authentic bacteriological studies had been made, thirty-eight were associated with a pure or mixed infection with *B. typhosus*. In only one case was there a supposed mixed infection with *B. coli*, which naturally would be the most common secondary invader. This was a case of Klemm's Déhu²⁵ (1893) in his elaborate statistics stated that *B. coli* had never been seen in bone abscesses and without excluding the possibility of its occurrence he regarded it as extremely improbable that the colon bacillus held any relation to the production of osteitides.

Recently Blumer²⁷ has reported a case in which *B. coli* was supposed to have been isolated from a post-typhoidal bone abscess. His organism, however, was an alkali-producer of milk and therefore probably did not ferment lactose and should hardly be regarded as a colon bacillus. No mention occurs of serum reactions in his report, and it is quite possible that the organism isolated was the specific cause of the fever preceding the osteomyelitis and was a member of the group in question.

BACTERIOLOGICAL SURVEY OF THE BACILLUS. (*Bac. O*.)

For purposes of comparison inoculations were made upon all media, with the following organisms:*

²³ Quinke, H., und A. Stühlen: Zur Pathologie des Abdominal typhus. Typhusbacillen im Knochenmark. Berliner klinische Wochenschrift, Bd. XXXI, No. 15, p. 351. April 9, 1894.

²⁴ Keen, W. W.: Complications and Sequels of Typhoid Fever. Philadelphia, 1898, p. 113.

²⁵ Klemm: Quoted by Keen, op. cit., p. 113.

²⁶ Déhu, Paul: Etude sur le rôle du bacille d'Eberth dans les complications de la fièvre typhoïde. Thèse de Paris, 1893, p. 1.

²⁷ Blumer, George: A Case of Post-typhoid Bone Inflammation due to the Colon Bacillus. The Pacific Record of Medicine and Surgery, Vol. XIII, p. 105, November 15, 1898.

* 1-2-3-4-5-9-10-11 were obtained through the kindness of Dr. Harris from the laboratory stock cultures. To Dr. Harris and his assistants, Mr. Winnie and Mr. Holden, I am indebted for confirmation in some of these observations. 6-7-8 were obtained from Cambridge through the courtesy of Dr. Herbert E. Itham. Three additional varieties of *B. icteroides* from different sources were kindly sent to me by Dr. Reed from Washington.

1. *B. typhosus* (a), an early alkali-producer. (3 weeks);
2. *B. typhosus* (b), a late alkali-producer (months);
3. *B. coli communis* (a), var. not fermenting saccharose;
4. *B. coli communis* (b), var. fermenting saccharose;
5. *B. paracolon* (Gwyn);
6. *B. enteritidis* (Gärtner);
7. *B. morbificans bovis* (Basenau);
8. *B. var. "Hatton"* of Durham;
9. *B. cholerae suis*;
10. *B. icteroides* (Sanarelli);
11. *B. typhi murium* (Loeffler);

us giving a variety of intermediate forms, as well as the chief variations in the extreme groups of colon and typhoid.

MORPHOLOGY, ETC.—*Bacillus O* could not be distinguished from the typhoid bacillus in form or staining qualities and description is therefore unnecessary. It decolorized by am. Variations in size were observable upon different media and occasionally sedimenting organisms were found to take a polar stain. Flagella in number and distribution resembled those of *B. typhosus*. Twelve to fourteen were counted on some specimens and occasionally exceedingly long terminal flagella were observed. Of the above bacilli it is possible that Basenau's organism (No. 7) alone could have been distinguished from the rest with any degree of probability. The variety which Dr. Durham had presented tended to grow in filamentous forms quite recognizable upon most media.

Active motility was present with all varieties except those of *B. coli* which, under the same cultural conditions, showed only sluggish movements, or no motility whatever. The motility of *Bac. O* was especially active, being darting in character, and remained present for many days.

AGAR AND GELATIN.—The appearance of colonies and of surface growth upon these media presented no features by which they could with any certainty be distinguished. All were very typhoid-like, the luxuriance of surface growth depending somewhat upon the initial reaction. Basenau's organism again is perhaps an exception, as the surface colonies on gelatin presented a more irregular fringed edge than the others which ordinarily showed a pale brownish-yellow centre growing toward the periphery; this was usually slightly scalloped, well defined and almost colorless.

GROWTH IN BOUILLON.—*Bacillus O* and Gwyn's "paran" in bouillon and similar media grew much less luxuriantly than did the various intermediate forms used for comparison. The hog cholera and Gärtner type cloud the media more rapidly and more abundantly than *B. coli*, and usually a surface pellicle is formed which may or may not fall. The other organisms, on the contrary, produce but slight turbidity and thus resemble the typhoid rather than the colon of the group. One series of bouillon inoculations, the medium having an initial reaction of + 1.2 (that is, 1.2 cc. of normal tenth standard solution of sodium hydroxide

was required to neutralize 10 cc. of the medium), gave after five days of incubation the following reactions:*

B. coli (a).

Branch. Slightly cloudy; large bubble of gas. Initial reaction + 1.2; terminal reaction + 1.6; production of acidity .4 per cent.

Bulb. Very cloudy; abundant precipitate; slight pellicle. Initial reaction + 1.2; terminal reaction + 1.6; production of acidity .4 per cent.

B. typhosus.

Branch. Very slight cloud; no gas. Initial reaction + 1.2; terminal reaction + 1.4; production of acidity .2 per cent.

Bulb. Slight cloud; slight precipitate. Initial reaction + 1.2; terminal reaction + 1.4; production of acidity .2 per cent.

Bacillus O.

Branch. Very slight cloud; small bubble of gas. Initial reaction + 1.2; terminal reaction + 1.3; production of acidity .1 per cent.

Bulb. Slight cloud; abundant precipitate; no pellicle. Initial reaction + 1.2; terminal reaction + 1.0; production of alkalinity .3 per cent.

B. Gärtner et al.

Branch. Very slight cloud; small bubble of gas. Initial reaction + 1.2; terminal reaction + 1.4; production of acidity .2 per cent.

Bulb. Very cloudy with abundant precipitate and pellicle. Initial reaction + 1.2; terminal reaction + 0.9; production of alkalinity .5 per cent.

It is thus seen by the cloudiness of the closed arm and by the acid produced that a carbohydrate present in ordinary bouillon permits all of these organisms to grow anaerobically. The intermediate (Gärtner) and colon forms with their allies produce a small amount of gas. The aerobic growth in the open bulb remains acid in the case of colon and typhoid but produces with the rapidly growing Gärtner type some degree of alkalinity, which in a short time is sufficient to overcome the preliminary acidity.

GROWTH IN DUNHAM'S SOLUTION AND DEXTROSE-FREE-BOUILLON WITH INDOL REACTIONS.—In *dextrose-free-bouillon* the vigor of growth of the Gärtner-Hog Cholera type is especially well shown, the great cloudiness and rapid formation of surface pellicle, most marked with *B. typhi murium* and *B. morbif. bovis*, being very characteristic. *Bac. O* and Gwyn's organism here again grow much more like the typhoid

* The percentage of reactions given throughout this paper represents the amount of normal sodium hydroxide or oxalic acid solution requisite to neutralize, by the phenolphthalein test, 10 cc. of the fluid in question. For the purpose of titration normal tenth solutions were used. In all cases an uninoculated control, having undergone corresponding incubation and exposure, was similarly tested to give the initial reaction. As recommended by the committee of American bacteriologists,²⁸ the plus and minus signs are used to indicate respectively acidity and alkalinity.

²⁸ Procedures Recommended for the Study of Bacteria: Submitted to the American Public Health Association in Phila., Pa., Sept., 1897. Rumford Press, Concord, N. H., 1898.

bacillus. The same may be said of their growth in *Dunham's solution*.

In the latter medium after seven days incubation no indol could be demonstrated for any of the intermediate forms, while *B. coli* gave its usual marked reaction. Theobald Smith, however, has shown²⁹ that the carbohydrate which Dunham's peptone solution (generally used for this test) contains, exercises a restraining action on the production of indol, while in dextrose-free-bouillon * there is no such retardation. A careful test, therefore, was made for *B. typhosus*, *B. coli com.*, *Bac. O* and *B. paracolon* (Gwyn) on the principles laid down by Dr. Smith, and by this means very slight traces of indol, not apparent in Dunham's solution, were appreciable for the two latter organisms after the 8th, 9th and 10th days. The method employed was as follows:

Daily, over a period of ten days, four tubes of dextrose-free-bouillon (properly tested for muscle sugar) were inoculated respectively with a typhoid, colon, paracolon (Gwyn) and *Bacillus O* and placed in the thermostat. At the end of this period all 40 tubes were tested at the same time for indol with freshly prepared standard solutions. The colon bacillus showed after 24 hours a faint trace of indol which increased in intensity up to the 10th day. With typhoid no trace was demonstrable. Gwyn's paracolon on the 8th, 9th and 10th days showed a faint trace and similarly *Bacillus O* in the older tubes gave evidence of a slight production of indol, possibly a little more than the paracolon. These reactions were positive, though slight, and might readily have been overlooked on a single tube test. In Gwyn's original report a belief is expressed in the non-production of indol. On another occasion a similar series of inoculations for comparison with the other members of the intermediate group gave no reaction whatever for any of the organisms up to the 10th day. The culture of *Bac. O* used at this time was several generations removed from the original.

Apparently, from Peckham's elaborate observations,³⁰ the reaction for indol should not be given the prominence in questions of differentiation of bacillary types that has been attributed to it by Kitasato and other writers who have regarded this as a most important and distinguishing characteristic of *B. coli communis*. According to the source of the culture, however, and possibly depending upon the proteid characteristics of the nourishing medium, there is great varia-

bility in indol production, which, if the observations of Klecki, Dreyfuss, Sanarelli and others are to be depended upon, is in some degree a measure of pathogenicity. Peckham has shown that *in vitro* this property of indol production may be made to vary within wide limits by cultivation in various media. Indeed she has been able to obtain an indol-producing typhoid and to cause *B. coli* to lose this property. As ordinarily encountered in the human body, however, *B. coli* produces indol, and the members of the intermediate group under discussion barely appreciable amounts, if at all, through the forms *Bac. O* and Gwyn's paracolon were obtained from sources and under conditions which, according to Peckham, would have been most favorable, if the conclusions of her observations are a standard, toward the acquisition of this characteristic.

GROWTH ON POTATO.—This is a very uncertain means of differentiation. *B. coli* doubtless grows more luxuriantly in this medium and shows more marked chromogenetic properties. All depends, however, upon the initial reaction of the potato. Occasionally the intermediate bacilli have been seen to grow almost like *B. typhosus*, at other times almost as profusely as colon, but on such occasions the typhoid bacillus itself after a longer incubation would present the same appearance. *Bac. O* and *B. paracolon* (Gwyn) behaved like the typhoid, *i. e.*, grew more slowly, darkened the potato more rapidly and assumed a yellow color later than the other intermediate varieties. On one occasion a series of inoculations was made on potato which had an initial reaction of +8*. All of the intermediate forms of Gärtner type gave an abundant, visible, slightly elevated, smooth, glistening, opaque growth of light-yellow color in 24 hours, which deepened in 48 hours, with an accompanying discoloration of the potato. In four days the potato had assumed a dirty-gray color in all these intermediate forms. *B. typhosus*, *Bac. O* and *B. paracolon* growing more slowly finally gave the same appearance in six days or more. At the end of four days in the presence of the Gärtner type the potato had a reaction of -4.0, thus 12 per cent of alkalinity had been produced by the growth of the organism in this time. The unreliability of the potato reaction is thus exemplified. The intermediate forms, as well as *B. typhosus*, are alkali-producers when grown in the presence of air, and this alone is responsible for the change in appearance of the medium. This may be demonstrated by adding a corresponding amount of alkali to the potato and incubating it for a few hours when it assumes the same dirty-gray color. *B. coli*, however, produces its abundant growth without formation of alkali products, the medium remaining free from the discoloration of the alkali-producers.

²⁹ Smith, Theobald: A Modification of the Method for Determining the Production of Indol by Bacteria. The Journal of Experimental Medicine, Vol. II, p. 543, 1897.

* For method of preparation cf. Smith, Theobald, Ueber Fehlerquellen bei Prüfung der Gas- und Säure-bildung bei Bakterien und deren Vermeidung. Centralblatt für Bakteriologie, u. s. w. Band XXII, 1897, No. 2/3, S. 49.

³⁰ Peckham, Adelaide Ward: The Influence of Environment upon the Biological Processes of the Various Members of the Colon Group of Bacilli. The Journal of Experimental Medicine, Vol. II, p. 549, 1897.

* These reactions were roughly made by titrating 5 cc. of a neutral solution, in which the potato had been shaken up for five minutes, both before inoculation and 5 days after growth. Presumably this represents but a small measure of the true reaction.

MILK.—The reactions in milk and the various media made in it, depending upon the variations in the rapidity and degree of acidulation or alkalization of the medium, constitute one of the most important means of differentiation of members of the typhoid-colon family.

B. coli, as is well known, acting upon its carbohydrate contents, acidulates milk up to the point of precipitation of casein (6-8 per cent of acidity) in periods varying from 2 to seven days and at the same time there is a liberation of gas amounting to about 1/6th of the closed arm of a fermentation tube. Here acidulation ceases, the organism ceasing to grow or being inhibited in its growth by the acid formed. But the organism is capable of producing a larger amount of acid from the contained carbohydrates is shown by the acidulation of milk which, having acquired a previous alkalinity of 4 per cent from the growth of an intermediate form, subsequently inoculated with *B. coli*, which not only overcomes the original organism but overcomes its alkali-producing power and finally precipitates the casein which this had held in solution.

B. typhosus also is an acid-producer but, unlike colon, not to the degree of coagulation of the medium. If plain milk requires 6 per cent to completely precipitate the casein, milk which *B. typh.* has been grown for 48 hours requires but 4 per cent. There are varieties, however, which when grown in milk in the presence of air, lose their acid reaction and become neutral or alkaline. Occasionally this is a noticeable and early change, occurring in a few weeks, and has given rise to the name "blue typhoid" from the unusual color which follows its growth in litmus milk. It is a characteristic, however, which seems to belong remotely to all examples of *B. typhosus*.

The intermediate bacilli under discussion have a very different reaction in milk, namely, that of an early and distinctive alkalization of the medium in the presence of air, which occurs after a transient acidity of a few hours. This alkalization progresses up to the point of solution of the casein (at 4 per cent of alkalinity) and thus with the liberation of the fat-globules gives to the medium the peculiar greenish opalescence and translucency which has been said to be characteristic alone (?) of the Hog-Cholera bacillus, but which results similarly from the growth of all members of the group, in fact without the bacteria can be occasioned by the addition of a corresponding amount of alkali to the milk. This alkalization in the presence of the growing organisms begins to be apparent in about two weeks, that is, sufficient alkali has been produced to partly dissolve the casein and render the medium slightly translucent. After entire solution has taken place (4-6 weeks) the liberated fat-globules, freed of their surrounding casein envelopes, are found floating upon the surface leaving the medium fairly clear, often with a gelatinous deposit at the bottom of the tube, consisting chiefly of a mass of organisms which take a feeble and bipolar stain and are apparently dead. The opalescent medium above contains a comparatively small number of viable evenly staining bacilli.

The accompanying photographs (Plate VIII, Fig. I (a) and (b)) of a series of tubes show the appearance of this reaction in the case of the intermediate bacilli contrasted with that of *B. typhosus*, *B. coli* and a control tube, all of which have retained their original opacity. Boiling has no apparent effect on the milk which has undergone this change.

In litmus milk the transient acid reaction* and subsequent alkalization are shown by the color changes. The opalizing reaction from solution of the casein, if present, is not apparent in the litmus medium. The bulb of the fermentation tube after a few days acquires a blue color which deepens in time to a dark navy blue corresponding to the color which follows the addition of 4 per cent or more of alkalinity to a control tube. At varying periods, during the activity of growth, at the bottom of the test-tube or in the closed arm of the fermentation tube the litmus becomes reduced and colorless. These reactions all take place more slowly with *Bac. O* and Gwyn's paracolon, and in fact Gwyn did not recognize this terminal alkalinity of milk, which does not occur for 12 to 14 days. The neutralization period for *Bac. O* does not appear till the 8th day. This relative slowness in alkalization should hardly separate these two varieties from the Gärtner or Hog Cholera type any more than that slow production of acidity sufficient to precipitate casein should separate one variety of colon from another which coagulates milk in half the time.

These results may be expressed as follows:

1. Colon acidulates milk up to the point of precipitation of the casein in from 2 to 7 days.

B. coli. Seven-day growth in fermentation tube of milk having an initial reaction of +2.2. Total gas 1/6. Coagulation of milk in 2 days.

Reaction { Branch (terminal) + 8.8 less 2.2 = 6.60% acid produced.
Bulb (terminal) + 8.8 less 2.2 = 6.60% acid produced.

2. Typhoid produces in milk from 1-2 per cent of acidity, not enough to coagulate the medium. In other words, it requires 1-2 per cent less of acidity to precipitate the casein after the growth of *B. typhosus* than in control milk. Further, as Theobald Smith³¹ has shown, the addition to milk in sufficient amounts of a carbohydrate, such as dextrose, which can be acted upon by *B. typhosus*, will lead to the coagulation of the medium.

* This slight early acidification in milk, so rapidly overcome by the production of an alkaline product, is presumably due to the presence in milk of traces of a fermentable substance which Theobald Smith believes to be a second carbohydrate, possibly dextrose. Neither *B. typhosus* nor any member of the intermediate group appears to have any reducing effect upon lactose in otherwise sugar-free media. For this reason the reactions in lactose sugar-free bouillon and in milk are not supplementary as ordinarily supposed.

³¹ Theobald Smith: The action of typhoid bacilli on milk, and its probable relation to a second carbohydrate in that fluid. The Journal of the Boston Society of Medical Sciences, Vol. II, No. 12, p. 236, June, 1898.

B. typhosus. Seven-day growth in fermentation tube of milk having initial reaction of + 2.2. No gas. No coagulation.

Reaction { Branch (terminal) + 3.8 less 2.2 = 1.60% acid produced.
Bulb (terminal) + 3.8 less 2.2 = 1.60% acid produced.

3. The intermediate type produces a transient acidity followed by a marked alkalinity in the presence of air which increases from 0 per cent in 3 days to 4 per cent in two weeks with solution of the casein and the consequent production of partial translucence of the medium. This, however, only occurs in the presence of air. Such opalization does not occur in the closed arm of the fermentation tube. When such a reaction has occurred the addition of 4 per cent of acidity will again render the medium opaque and 10 per cent (6 per cent of acidity must be reached) must be added to precipitate the casein formerly held in solution by the alkali. Thus there is 10 per cent difference of reaction between the point of coagulation produced by the acid of *B. coli* and the point of solution of the casein produced by the alkali of the intermediate group.

B. Gärtner et al. Seven-day fermentation reactions with milk of + 2.2 initial reaction. Total gas = bubble. No coagulation.

Reaction { Branch (terminal) + 3.8 less 2.2 = 1.60% acid produced (cf. *B. typhosus* (2)).
Bulb (terminal) + 0.2 less 2.2 + 1.6 = 3.60% alkali produced.

3a. The allied forms, *Bac. O* and *B. paracolon* (Gwyn) show a corresponding but slower reaction.

Bac. O, etc. Fermentation reaction in plain milk (7 days) with initial acidity of + 2.2. Gas bubble +. No coagulation.

Reaction { Branch (terminal) + 3.9 less 2.2 = 1.70% acid produced (cf. *B. Gärtner* (3)).
Bulb (terminal) + 0.6 less 2.2 + 1.7 = 3.30% alkali produced (cf. 30% less than with Gärtner type in same time).

FERMENTATION REACTIONS WITH VARIOUS SUGARS.

A valuable means of distinguishing varieties of the colonic typhoid group lies in their reactions in the presence of various carbohydrates. Theobald Smith regards this process of differentiation as most essential; "a relief from the uncertainty of the usual potato culture and the variable intensity of the indol reaction." The methods which he advocates were adopted and his precautions observed. Several series of inoculations were made with most of the organisms in the list which has been given, in fermentation tubes of sugar-free bouillon containing 1 per cent of glucose, lactose, mannite or saccharose sugars. The rapidity of gas-production was daily registered at the level of fluid in the closed arm; the proportion of CO₂ to explosive gas was finally noted and the reactions of the bulb and closed arm at varying periods were made an object of record and comparison. All of the observations

were made during incubation at a temperature of 37°. The original bouillon * in all instances, to insure its freedom from muscle sugar, was tested by inoculation and incubation with a gas-producing organism before its sugar percentages were added.

Reactions in Lactose. Owing to the observations of Smith which have been reviewed above, upon the presence in milk of a fermentable substance other than lactose, some reservations must be made to the common belief in the correlation between the reactions in plain or litmus milk or in the litmus whey of Petruschky,³² on the one hand, and the reactions occurring in media made by adding the carbohydrate to otherwise sugar-free bouillon. In consequence of this fact a source of error may creep into the observations upon the fermentation of lactose, since the commercial product in use from milk may be adulterated with this second carbohydrate. Similarly, mistakes may arise owing to the case with which during the sterilization of lactose media some of the carbohydrate may be converted into a simple and more readily fermentable sugar. For this reason preparation in the autoclave should be avoided and the fractional method of sterilization be employed for this as well as for saccharose media. Furthermore, failure to insure complete freedom from muscle sugar in the original bouillon may lead to mistaken observations and it is doubtless due to these possibilities of error that so many conflicting statements are encountered regarding the fermentation of lactose by various bacteria. The accompanying photographs (Plate IX, Figs. 2 and 3), representing series of inoculations into lactose media, show how such erroneous observations may originate. In the series reproduced in Fig. 2 gas production was present in slight amount in all instances except with *B. typhosus*, and was presumably due to some dextrose adulteration. In the latter series, shown in Fig. 3, the original bouillon had not been completely freed from muscle-sugar, fermentation of which gave a small amount of gas. Before the addition of the 1 per cent lactose to the medium used in this series a corresponding amount of gas was produced in it by the inoculation with *B. coli communis*. Fig. 4 represents the typical reaction, *B. coli* alone producing gas from the carbohydrate, the other organisms producing no fermentative change whatever.

In the following table are given the reactions occurring in the bulb and branch of the fermentation tube resultant to the growth of these organisms in 1 per cent lactose media. The figures throughout these tables represent the amount of normal tenth sodium hydroxide or oxalic acid solution required to neutralize by the phenolphthalein test 10 cc. of the medium. An uninoculated control was in each instance similarly tested and these results represent the calculated production of alkali or acid. It will be seen that the figures of the intermediate group are practically the same in all cases.

* For methods of preparation cf. Theobald Smith, p. 546.

³² Petruschky, Johannes: Bakterio-chemische Untersuchungen. Centralbl. f. Bakteriologie. Bd. VII, S. 1, 49, 1890.

COMPUTED REACTION* AFTER 8 DAYS' INCUBATION WITH 1% LACTOSE SUGAR-FREE BOUILLON HAVING INITIAL ACIDITY OF 1.40%.

	B. typho- sus (a).	Bacillus O.	B.paracolon (Gwyn).	B. morbif. bovis.	B. var. "Hatton."	B. enter- itidis.	B. chol. suis.	B. icter- oides.	B. typhi mur.	B. coli comm. (a).	B. coli comm. (b).
Reaction of Bulb	Alkaline .40%	Alkaline .95%	Alkaline .90%	Alkaline 1.60%	Alkaline 1.00	Alkaline 1.00%	Alkaline .80%	Alkaline 1.60%	Alkaline 1.60%	Acid 3.60%	Acid 4.2%
Reaction of Branch	No change	No change	No change	Alkaline .20%	Alkaline .10%	Alkaline .10%	Alkaline .10%	Alkaline .20%	Alkaline .20%	Acid 3.60%	Acid 3.6%
Total Gas.....	0	0	0	0	0	0	0	0	0	1/2+	3/4
Proportion of H/CO ₂ ..	%	%	%	%	%	%	%	%	%	2+ /1	2+ /1

* The reactions represent the amount of acidity or alkalinity produced, and are computed from the initial reaction.

B. coli ferments lactose, producing an equal amount of acidity in closed arm and bulb, and gas composed of CO₂ and an explosive element (hydrogen) in the proportion of 1:2. No acid is produced by *B. typhosus* from pure lactose, despite the fact that ordinary milk is acidulated by its growth. The amount of alkalinity in the bulb, which occurs with this organism as well as with *Bac. O* is slightly less than that which follows the growth of the intermediate bacilli, possibly

owing to the fact that they grow with less luxuriance than the intermediate variety, which, in the presence of air, multiply rapidly in bouillon. Theobald Smith states that alkali production bears a distinct relation to vigor of growth. The slight alkalinity of from .1 to .2 per cent in the closed arm with the more rapidly growing intermediate forms may be due to some interchange of reaction with the very alkaline medium in the bulb.

COMPUTED REACTIONS IN DEXTROSE SUGAR-FREE BOUILLON HAVING INITIAL ACIDITY OF 1.50%.

	B. typhosus.	Bacillus O.	B.paracolon (Gwyn).	B. morbif. bovis.	B. var. "Hatton."	B. enter- itidis.	B. chol. suis.	B. icteroides.	B. typhi mur.	B. coli comm. (a).	B. coli comm. (b).
Reaction of Bulb	Acid 3.50%	Acid 3.50%	Acid 3.60%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.90 % 4.10 %	Acid 3.80 % 4.10 %
Reaction of Branch	Acid 3.50 %	Acid 3.70%	Acid 3.70%	Acid 3.90%	Acid 3.90%	Acid 4.10%	Acid 3.90%	Acid 4.15 %	Acid 4.15 %	Acid 4.15 % 4.50 %	Acid 3.90 % 4.50 %
Total Gas.....	0	$\frac{1}{3}-\frac{1}{2}$	$\frac{1}{3}-\frac{1}{2}$	$\frac{2}{5}-\frac{1}{2}$	$\frac{2}{5}-\frac{1}{2}$	$\frac{2}{5}-\frac{3}{5}$	$\frac{2}{5}-\frac{1}{2}$	$\frac{1}{3}-\frac{3}{5}$	$\frac{2}{5}-\frac{1}{2}$	$\frac{1}{2}+$	$\frac{1}{2}-$
Proportion of H/CO ₂	%	2+ /1	2/1	2+ /1	2+ /1	2+ /1	2+ /1	2+ /1	3/1	2/1	2/1

Reactions with Dextrose. All of the members of the Hog Cholera or Gärtner group produced gas, in correspondence with *B. coli* and its allies, when grown in the presence of lextrose. The total displacement in the closed arm of the fermentation tube was found to vary somewhat under different conditions of inoculation. Two series as represented in the photographs (Plate X, Figs. 5 and 6) are given in illustration of this irregularity. One feature, however, is brought out in each series, namely, the relative slowness of gas-production with the two allied forms, *Bacillus O* and Gwyn's *paracolon*, which in the first twenty-four hours produce less than half as much gas as the other organisms.

Reactions with Mannite. Like dextrose, this carbohydrate is readily fermented by the organisms in question (cf. Plate XI) with the production of even a greater amount of gas, which, under some circumstances (cf. Fig. 8), may displace

the larger part of the fluid in the closed arm. In this series *Bac. O* was, as in the presence of dextrose, slow in its liberation of gas. One peculiarity of the reactions with mannite lies in the terminal reaction of the bulb which remains neutral or slightly alkaline, as does the media containing non-fermentable sugars (lactose and saccharose). The proportion of CO₂ in the gas was less than with dextrose, being 1/3 or less of the total amount. In several instances there was failure to demonstrate that the remainder contained any H or other explosive element.

Reactions with Saccharose. In the preparation of saccharose bouillon, as well as with lactose, precautions must be taken during sterilization to avoid any conversion of the carbohydrate into more readily fermentable sugars. No gas is produced and no acid formed by any of the intermediate group in this medium. Certain forms of *B. coli* also fail to

ferment saccharose, as is shown in Plate XII, Fig. 9. This has been pointed out by Theobald Smith. Other varieties of colon produce an abundance of gas, as is shown in Fig. 10 (*B. coli comm. (b)*). In the series presented in this latter photograph there had been a slight conversion of the sugar as the medium had been autoclaved. In several instances, consequently, a slight production of gas has resulted, showing the source of error which may result from this method of sterilization. The slowness of the growth of *Bacillus O* and Gwyn's *paracolon* heretofore commented on was shown in the closed branches of these tubes by the tardy reduction and decolorization of the litmus which had been added to the media. This is apparent in the photograph. In the accom-

panying table are given the reactions which occur after growth in saccharose media. It will be seen that the more rapidly growing organisms have produced a greater percentage of alkalinity in the presence of air and that a small percentage (.2 per cent) is present in the closed arm, possibly due as in the case of lactose reactions to some interchange in reaction with the bulb. The initial reaction of the medium in this series was + 1.0 and the reaction for the Gärtner or Hog-Cholera type after 9 days when the tests were made was + .8 for the closed arm and - 1.4 for the bulb. On the occasions when there was slight gas-production due to faulty preparation of the medium, a sufficient amount of acidity was found to delay alkalization in the bulb.

TABLE OF COMPUTED REACTIONS IN 1% SACCHAROSE SUGAR-FREE BOUILLON.

	<i>B. typhosus.</i>	<i>Bacillus O.</i>	<i>B. paracolon (Gwyn).</i>	<i>B. morbil. bovis.</i>	<i>B. var. "Hatton."</i>	<i>B. enteritidis.</i>	<i>B. cholerae suis.</i>	<i>B. icteroides.</i>	<i>B. typhi mur.</i>	<i>B. coli comm. (a).</i>	<i>B. coli comm. (b).</i>
Reaction of Bulb	Alkaline 2.0%	Alkaline 2.0%	Alkaline 2.0%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Acid 5.0%
Reaction of Branch.....	Neutral.	Neutral.	Neutral.	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Acid 5.0%
Total Gas..... (cf. Plate V).	0	0	0	0	0	0	0	0	0	Occasional bubble.	½
Proportion of H/CO ₂ ..	%	%	%	%	%	%	%	%	%	?	2 + 1

Pellicle formed on bulb with 4, 5, 6, 7, 8, 9. Reactions taken on 9th day. Five days of original incubation.

SCRAPED-TUBE REACTION.

For the differentiation of closely related bacilli, Achard and Renault³³ originated a method of inoculation of one organism upon a base which previously had served for the growth of another allied form. The development of the growth upon such a substratum was regarded as evidence of individuality and its failure as evidence of identity of the organisms. Many inoculations of this nature were made in the following way: After 72 hours of incubation at 37° C., the growth from the upper half of an inoculated agar slant was carefully removed and the tubes replaced in the thermostat to insure no further growth. Inoculations of these tubes were then made in a single streak along the centre of the area formerly occupied by the original growth and the results recorded after 72 hours of further incubation. How much reliance is to be placed upon this method of Achard is undetermined. Smith³⁴ does not regard it as an important

criterion, since slightly increased sensitiveness to acids or alkalis which may characterize closely related organisms may affect it.

It can be seen on consulting the table that none of the organisms could furnish a visible growth when reinoculated on their original substratum. In the case of *Bacillus O*, both typhoid and colon grew on its original surface of growth while none of the allied forms grew with any luxuriance. Gwyn's *paracolon* did not furnish any growth, but on the contrary *Bac. O* grew well upon the substratum of the *paracolon*. Similarly, although *B. coli* grew well upon the base of *Bac. O*, the latter gave no growth whatever on a colon substratum, though this was repeated with eight varieties of colon. It can, however, be said that the members of the intermediate group under most circumstances in which the reactions were tried failed to show on a substratum of one of its allies a growth of any vigor.

THERMAL DEATH-POINT.

Tests made by Mr. Winnie to determine the thermal death-point showed that an exposure at 60° C. for five minutes would prevent further growth of *Bacillus O*. A corresponding incubation at 55° C. failed to completely destroy the organisms, many colonies appearing on plate culture. Similarly, after a ten-minute exposure at the same temperature

³³ Achard et Renault: Sur les bacilles de l'infection urinaire. Semaine Médicale, 1892, p. 136. Sur les différents types de bacilles urinaires appartenant au groupe du bacterium coli. Ibid., 1892, p. 512.

³⁴ Smith, Theobald: Notes on the *Bacillus Coli Communis* and Related Forms. American Journal of Medical Sciences. Vol. CX, p. 283, 1895.

number of colonies appeared, though many less than after the shorter period of incubation.

PATHOGENICITY.

The object of this study has been merely an attempt at classification, and a lack of correspondence in pathogenicity may be no indication of the absence of phylogenetic relationship. Nevertheless, the following experiments, undertaken with some of these bacillary forms under discussion, are not without their instructive features. Most of the organisms which are members of this intermediate group possess

pathogenic properties of considerable virulence toward animals and may be the occasion of epidemics in hogs, cattle and other live stock, mice, birds, etc., and toward man as well as animals, as is evidenced by the various epidemics of meat-poisoning, yellow fever, etc.

Pathogenic experiments have never been undertaken with Gwyn's *paracolon*, and the notes concerning *Bacillus O*, found under somewhat similar circumstances in a case clinically one of typhoid fever, show that its virulence toward the lower animals in the condition of its isolation was not an intense one, but resembled the action of *B. typhosus* rather than that of other members of the Gärtner or hog-cholera group.

SUBSTRATUM OF—	TRANSPLANT OF—	Bacillus O.	B. coli.	B. paracolon.	B. typhosus.	B. enteritidis.	"B. var. Hatton."	B. cholerae suis.	B. icteroides.	B. morbil. bovis.	B. typhi. mur.
Bacillus O		No growth	Good growth	No growth	Good Growth	No growth	Faint	Faint	No growth	Faint	Faint
coli.....		No growth	No growth	Faint	Faint	No growth	....	....	....	....	....
paracolon... ..		Good growth	Fair growth	No growth	Faint	No growth	....	....	....	....	....
typhosus.....		No growth	Good growth	Fair growth	No growth	Fair growth	....	....	....	....	....
enteritidis		No growth	....	No growth	....	No growth	....	....	....	No growth	....
var. "Hatton".....		No growth	...	....	....	....	No growth	....	....	No growth	....
chol. suis.....		Faint	....	....	....	....	....	No growth	....	....	....
icteroides		No growth	....	....	....	....	....	....	No growth	....	....
morbil. bovis.....		No growth	....	....	....	....	....	....	....	No growth	....
typhi mur.....		No growth	....	....	....	....	....	....	....	....	No growth

A mouse was killed in 24 hours by a large subcutaneous inoculation of an 18-hour bouillon culture. The autopsy revealed lesions typical of an acute general septicæmia. A guinea-pig inoculated subcutaneously with a number of organisms sufficient in amount to invariably be fatal in the case of *B. chol. suis*, recovered after a small local area of induration which persisted for a week or two. Rabbits inoculated intravenously with large doses recovered after an acute illness and an occasional local lesion. No intraperitoneal inoculations were made.

Possibly the most interesting feature of the animal experiments lies in the fact that although the serum of an animal which had recovered from an inoculation did not possess any markedly agglutinative properties toward the other bacilli tested to that which had been inoculated; nevertheless, a certain protective immunity seemed to have been acquired. For example, a rabbit which had recovered from several inoculations with *Bac. O* and whose serum agglutinated this organism in 1-5000 dilution, recovered after an intravenous inoculation with a large dose of *B. chol. suis*, which was fatal to a control rabbit in a few hours. When killed 25 days later the former animal was found to have typical hog-cholera

lesions in the liver and elsewhere. Animals killed by infections with *B. enteritidis* had similar lesions in the liver, gall-bladder, duodenum, etc., and in fact the liver necroses do not seem to be characteristic of any one of these varieties, but merely to represent focal destructions of liver substance by accumulations of organisms present in too great abundance for elimination. There can likewise be seen in all cases lesions of the gall-bladder, with clumped organisms in the bile, which shows the usual changes seen in enteric diseases, of the gall-ducts and of the duodenum which is usually deeply injected and from which the organisms of infection may usually be isolated.

One observation of especial interest was the occurrence in the liver of a rabbit which had rapidly succumbed to an overwhelming dose of *B. cholerae suis*, of extensive fatty degeneration of the liver-cells resembling very closely the condition which is seen in the liver of human beings who have died from yellow fever. It is unusual to find this change in the livers of animals experimentally inoculated with *B. icteroides*, and this has been used as an argument against the possibility that Sanarelli's bacillus could be the cause of yellow fever and its characteristic hepatic degeneration.

RESULTS OF EXPERIMENTAL INOCULATIONS.

WHITE RABBIT I. Weight 1600 gms. Serum does not react to any member of the intermediate group.

July 13th, 1899. Inoculation in posterior ear vein with one cc. of a 24-hour bouillon culture of *Bac. O*.

July 15th. Ear greatly swollen. Animal quite ill. Refuses food. Temp. 106°.

July 16th. Temperature 104°. Much better.

July 17th. Apparently well. Lively. Eating.

July 20th. Blood taken for serum reaction. Thrombus in ear vein at seat of inoculation. Cultures from thrombus show subsequently several colonies of *Bac. O*. Serum agglutinates *Bac. O* in 1-700 dilution. Reaction complete in 30 mins. No reaction in dilution of 1-50 with *B. enteritidis*, *B. morbificans bovis* or *B. "Hatton."*

July 22nd. Reinoculated in other posterior ear vein with two cc. of 24-hour culture of *Bac. O*. Animal remained quite ill for several days. Recovered.

July 28th. Apparently well. Blood-culture negative. Serum reaction positive in 1-4800 dilution. Comparative serum reactions with other bacilli; *B. chol. suis* 1-200, fair reaction. *B. enteritidis* (Gärtner et al.) 1-10, negative.

The slight agglutinative reaction toward *B. chol. suis* suggested that the animal had acquired some resistance against hog cholera and a large fatal dose was given to this animal and to a control animal with the following results:

WHITE RABBIT I.

August 8, 1899. Intravenous inoc. of 1 cc. of 24 hour bouillon culture of *B. chol. suis*.

Aug. 10. Rabbit well.

Aug. 20. Blood taken for serum reactions shows a reaction toward *Bac. O* and *B. chol. suis* in 1-5000 dilution.

CONTROL ANIMAL, of same weight with negative serum reactions.

Aug. 8. Corresponding inoculation.

Aug. 9. Found dead (18 hours.)

Autopsy. General septicæmia. No mac. changes except injection of duodenal mucosa and an acute cholecystitis with bile thin and pale. Stained preparations from all organs, urine and bile showed a multitude of bacilli.

Cultures. Heart-blood, liver, gall-bladder, peritoneal cavity, and kidneys, *B. chol. suis* pure; urine, *B. chol. suis* and *B. Coli communis*.

Organs. Acute fatty degeneration of the liver.

August 28th. Comparative serum reactions of WHITE RABBIT I* with uninoculated organisms of the intermediate group as well as with *B. typhosus* showed that a slight tendency to agglutination more marked than before the last inoculation had been acquired. The reactions were as follows:

* Agglutinations were also positive with this serum, having a high reaction toward *B. chol. suis*, toward three individual cultures of *B. icteroides* (Sanarelli), sent by Dr. Reed from the Washington laboratory as follows:

Organism.	Dilution.	Reaction
Bacillus O.	up to 1-5000	Positive
Bac. chol. suis.	" " 1-5000	"
B. icteroides	" " 1-100	"
B. typhosus	" " 1-200	"
B. enteritidis (Gärt.)	" " 1-50	"
B. var. "Hatton"	" " 1-10	"
B. morb. bovis	" " 1-10	Negative
B. typh. mur.	" " 1-10	"
B. paracolon (Gwyn)	" " 1-10	"
B. coli com.	" " 1-10	"

1. Orig. culture from Roux's laboratory. Serum reaction positive up to 1-200, suggestive to 1-1000 in 2 hours.

2. *B. icteroides* from Santiago case, 1898. Serum reaction positive to 1-50; suggestive to 1-200 in 2 hours.

3. *B. icteroides* from Havana case, 1899. Serum reaction positive to 1-200; suggestive to 1-1000 in 2 hours.

Believing from these results that the animal had acquired in some degree a protective reaction toward other members of the intermediate group, although the clumping reaction was not marked in high dilutions, it was then inoculated with a fatal dose of *B. enteritidis* (Gärtner), as was also a normal control animal and another rabbit which had been immunized to *B. typhosus*.

INOCULATION WITH BAC. ENTERITIDIS (GÄRTNER).

WHITE RABBIT I. Serum reactions given above (Aug. 28).

Aug. 30. Inoc. in post. ear vein with 1 cc. of a 24-hour bouillon culture of *B. enteritidis* (Gärtner).

Aug. 31. Ill.

Sept. 1. Animal killed. Immediate autopsy. Caseous tubercle of ear at site of original *Bac. O* inoculation. (July 13.)

Abdomen. All organs apparently normal except liver and biliary apparatus. Section of former showed small focal necrosis. Gall-bladder normal in appearance but containing bile which was thin and pale and which had a yellow precipitate showing through the thin bladder walls. This consisted of desquamated cells and amorphous precip. of bile pigments. No organisms identified. Duodenal mucosa showed several minute hemorrhages in upper 5 cm. Duodenal papilla was erect and injected.

Cultures. Tubercle of ear, heart-blood, kidney and liver, sterile. From the gall-bladder an "intermediate" bacillus was isolated which could not be identified culturally. Identified by serum reaction, however, and shown to be *Bac. enteritidis* (Gärtner), as serum taken from rabbit with pure Gärtner infection clumped the organism in 1-500 dilution and had little effect on hog cholera and *Bac. O*.

Duodenum. An unidentified intermediate bacillus was isolated, presumably *B. Gärtner*, in pure culture.

Sections of the liver showed areas of focal necrosis involving whole lobules.

BLACK RABBIT—normal control.

Serum reactions negative in 1-10 dilutions to *Bac. O*, *B. chol. suis*, *B. enteritidis* and *B. typh.*

Aug. 30. Corresponding inoculation. (Cf. WHITE RABBIT I, Aug. 30.)

Aug. 31. Very ill.

Sept. 1. Found dead.

Autopsy. No decomposition.

Abdomen. Stomach full of food. Urinary bladder distended. No macroscopical changes apparent except in the biliary apparatus and duodenum. The gall-bladder was distended and injected full of hemorrhagic bile containing a flocculent precipitate.



1. *B. typh.* 3. *B. paracolon* (Gwyn). 5. *B. var.* "Hatton." 7. *B. icteroides.* 9. *B. coli.*
 2. *Bac. O.* 4. *B. enterit.* (Gärt.) 6. *B. chol. suis.* 8. *B. morb. bov.* (Bas.) 10. Control.

FIG. 1 (a)—Photograph of reactions in plain milk after 4 weeks. The diminution in opacity of the intermediate forms is well shown. Paracolon (Gwyn), producing alkali more slowly than the others, has not yet reached 4.0 per cent necessary for complete solution of the casein. *B. chol. suis* and *B. icteroides* have been shaken up and show the temporary settling of the surface layer of liberated fat-globules.

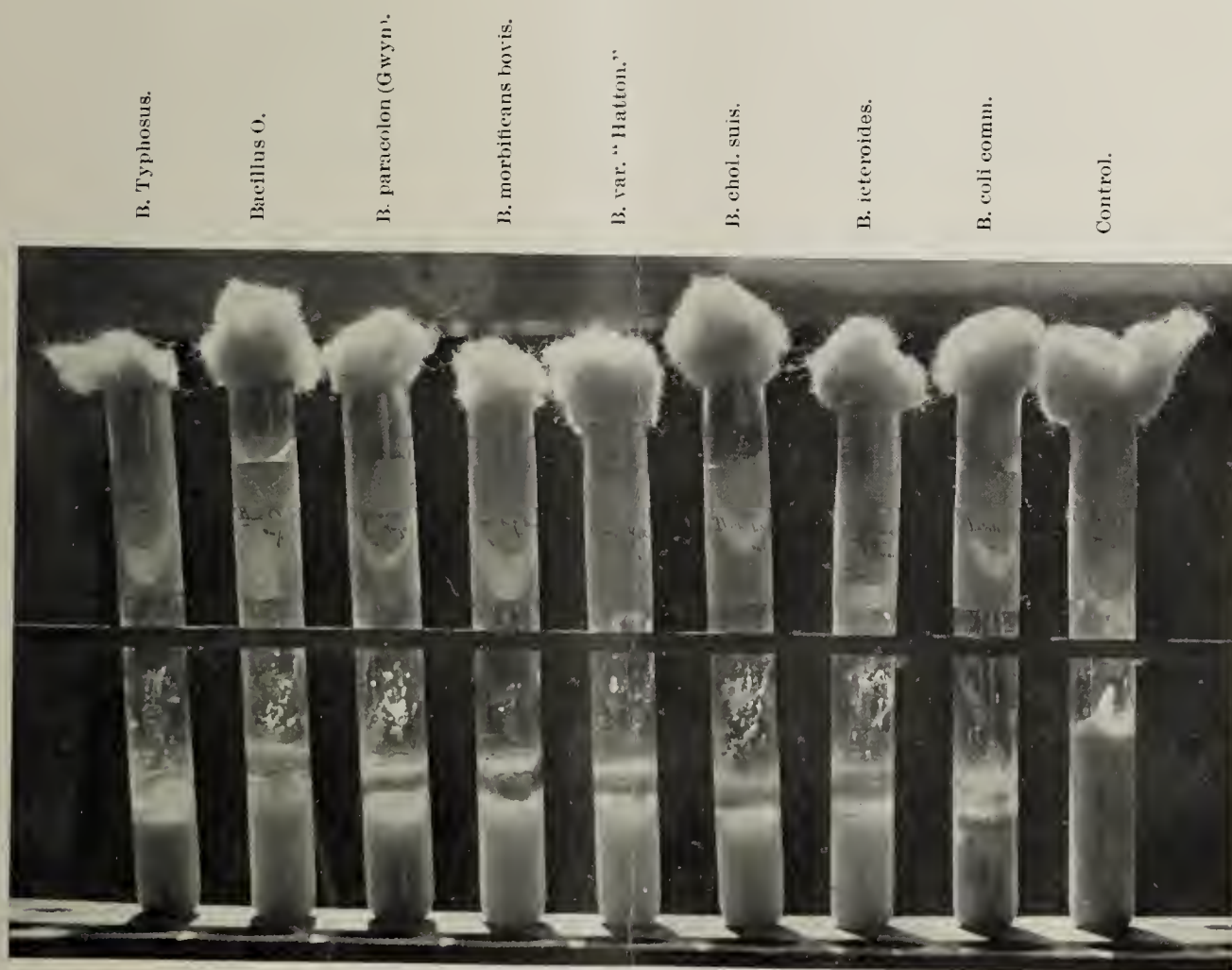
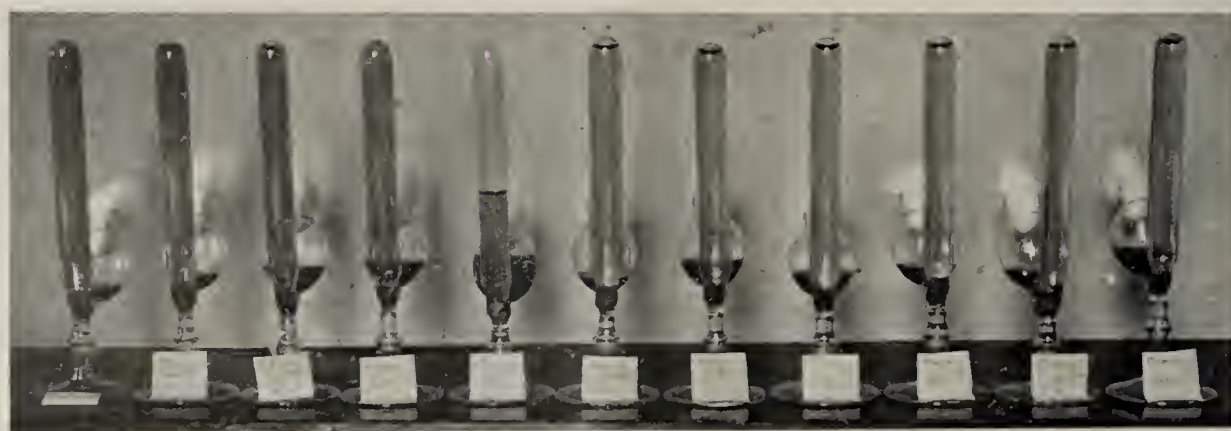


FIG. 1 (b)—Photograph taken with transmitted light of the same tubes as Fig. 1 (a), showing the comparative translucency of the intermediate group.



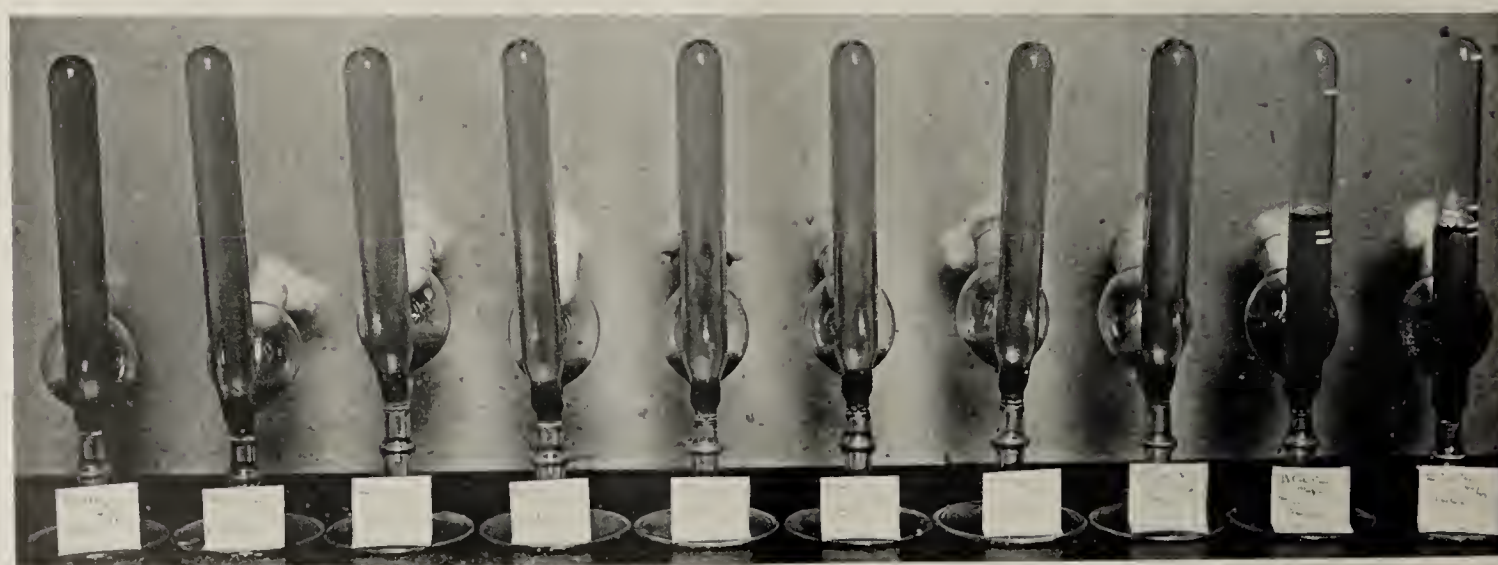
Control. B. paracolon. B. coli comm. B. ent. (Gärt.) B. chol. suis. B. typhi mur.
 Bac. O. B. typhosus. B. morb. bovis. B. var. "Hatton." B. icteroides.

FIG. 2.—Reactions in sugar-free bouillon containing 1 per cent of commercial lactose. Gas-production slight in intermediate group due to dextrose (?) adulteration.



B. morbif. bovis. B. chol. suis. B. icteroides.
 B. enteritidis. B. paracolon.

FIG. 3.—Reactions in the 1 per cent lactose bouillon not completely freed during its preparation from muscle-sugar. Slight gas-production except with B. paracolon.



Bacillus O. B. morbif. bovis. B. var. "Hatton." B. icteroides. B. coli (a).
 B. paracolon. B. enteritidis. B. chol. suis. B. typhi mur. B. coli (b).

FIG. 4.—Typical reactions in 1 per cent lactose sugar-free bouillon.



Bac. O. B. enterit. (Gärt.) B. chol. suis. B. typhi mur.
 B. paracolon (Gwyn), B. var. "Hatton." B. icteroides:
 FIG. 5.—Gas-production in sugar-free bouillon containing 1 per cent of dextrose.

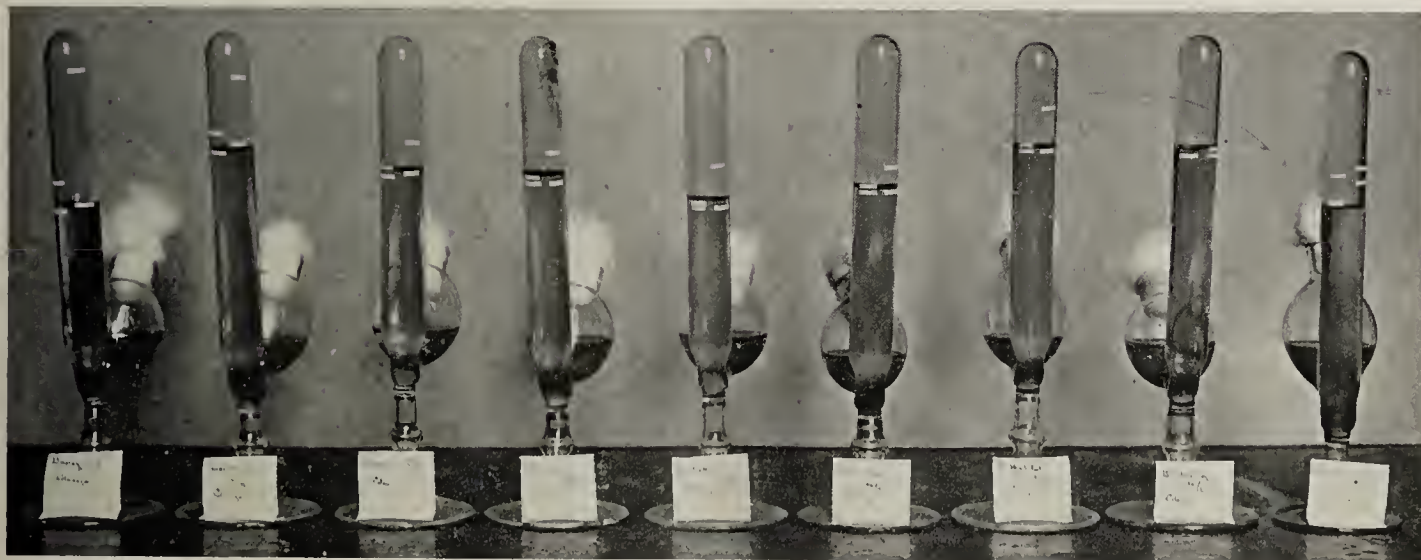


FIG. 6.—Gas-production in sugar-free bouillon containing 1 per cent of dextrose. For comparison with Fig 5. Showing relative slowness of gas-production with Bac. O and Gwyn's paracolon. The daily production of gas is indicated by labels.

FERMENTATION REACTIONS IN DEXTROSE BOUILLON.

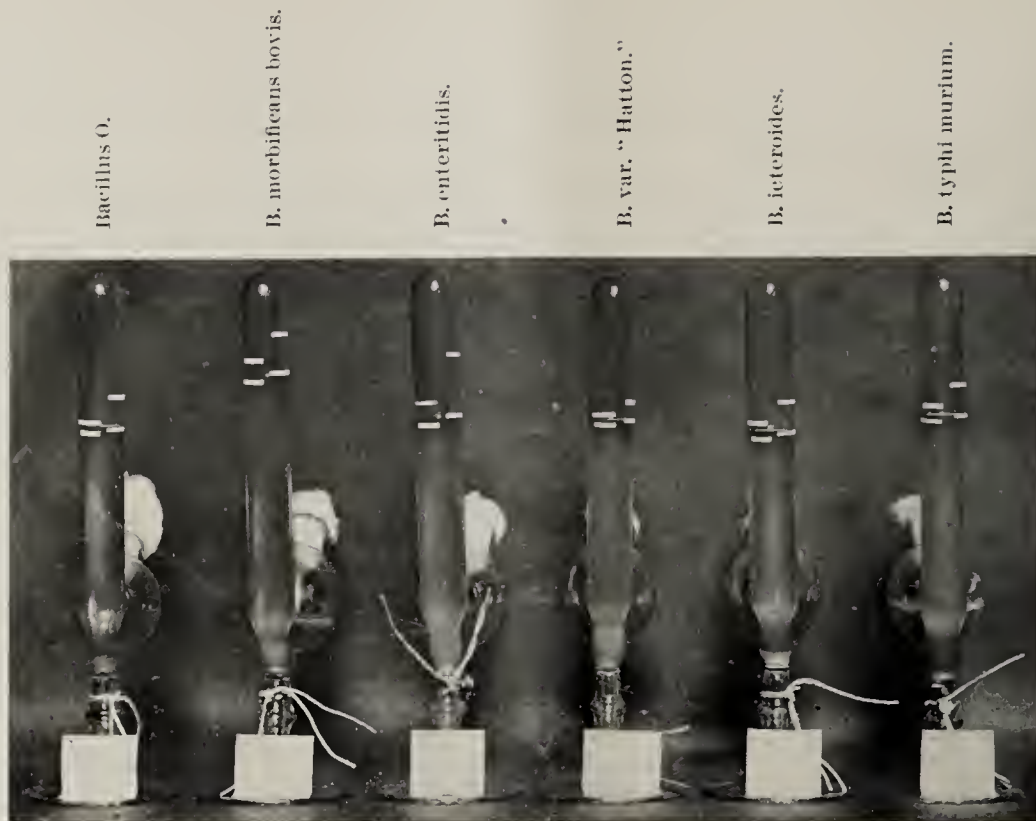


FIG. 7.—Reactions in sugar-free bouillon containing 1 per cent mannite.

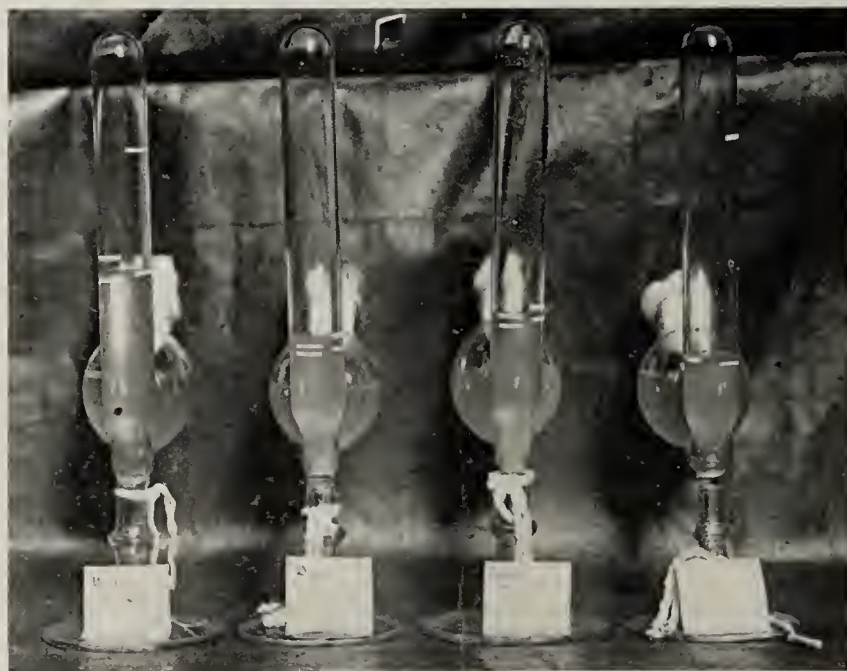


FIG. 8.—Reactions with 1 per cent mannite. Showing usual proportion of gas and rapidity of production with *Bacillus O.* The production of gas in the first twenty-four hours is usually small in comparison with the others unlike Fig. 7.

FERMENTATION REACTIONS IN MANNITE BOUILLON.

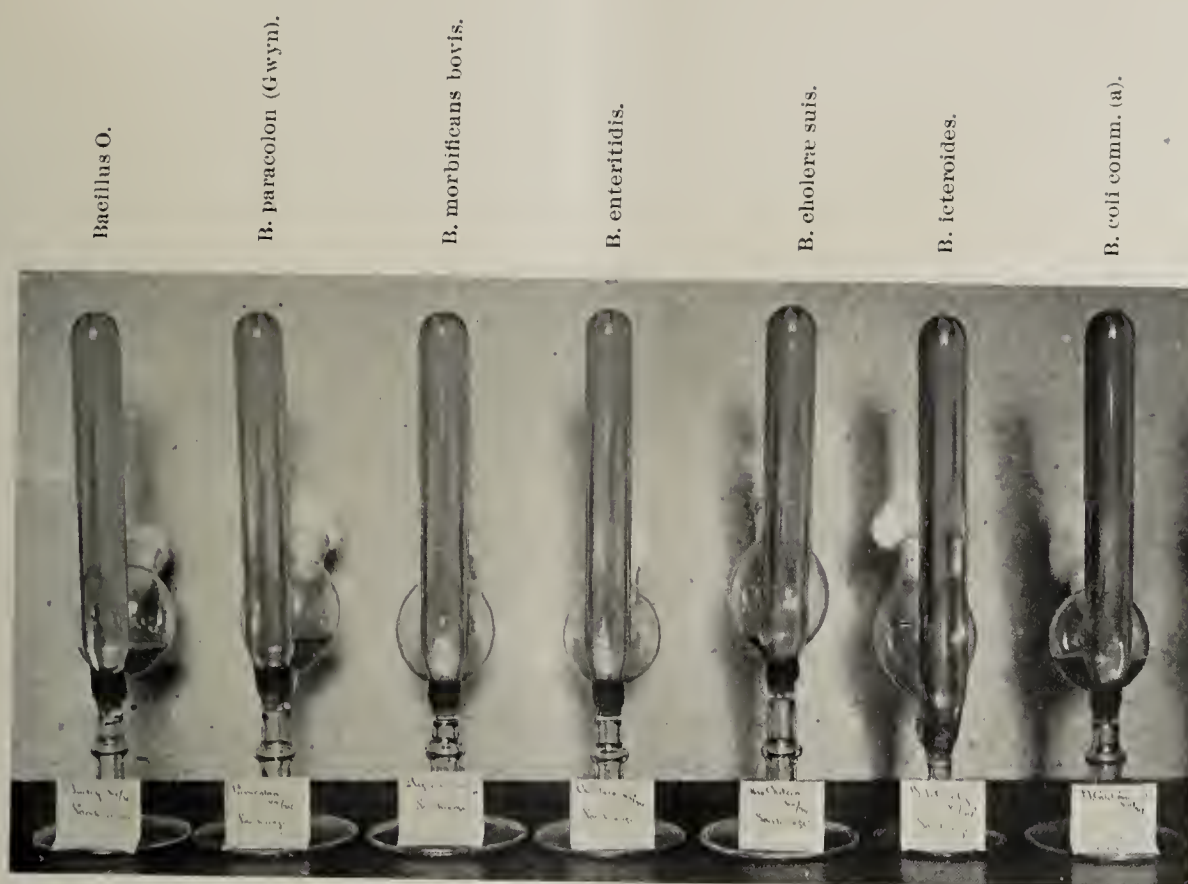


FIG. 9.—Reactions in sugar-free bouillon containing 1 per cent saccharose.

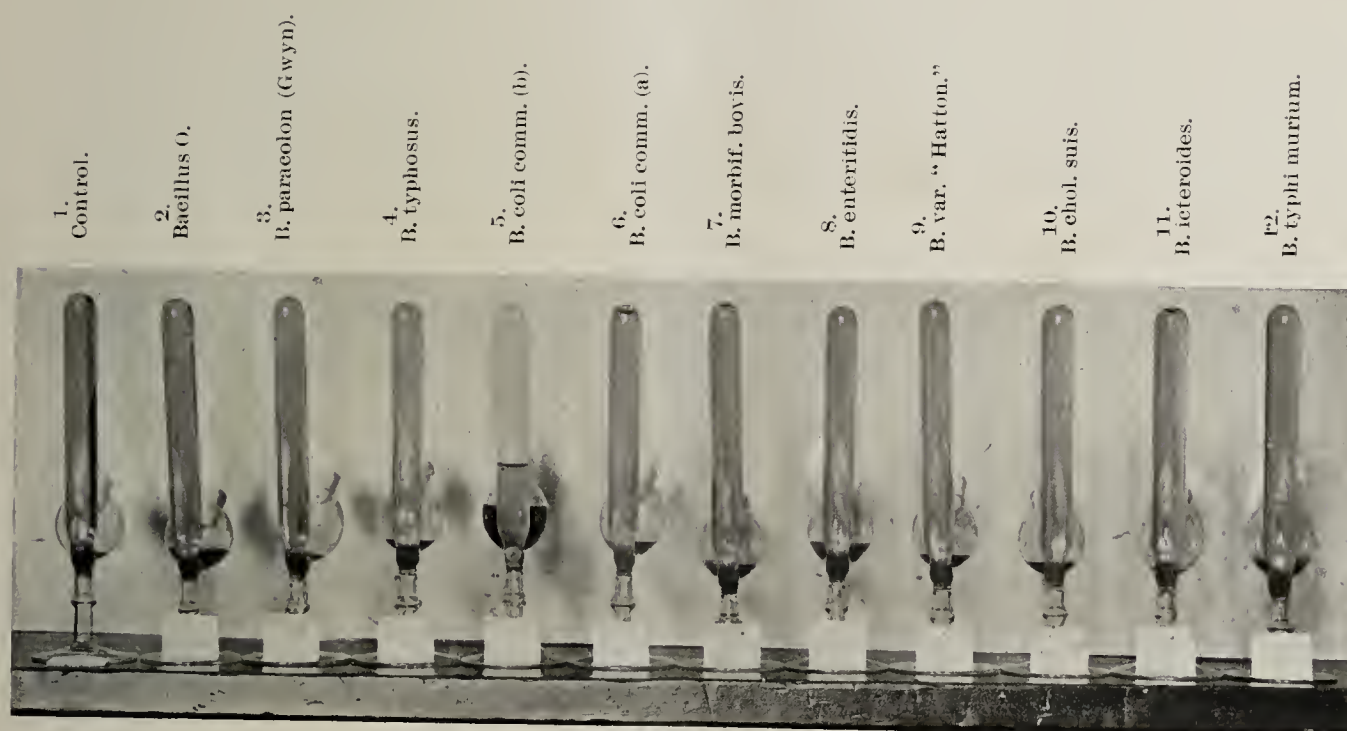


FIG. 10.—Reactions in 1 per cent litmus saccharose which had been partially converted during sterilization. Slight production of gas in tubes 2, 3, 6, 7, 9, 11, after 48 hours of incubation. At this time the litmus is completely reduced in the closed arm of the tubes containing the more rapidly growing organisms, 7, 8, 9, 10, 11, 12. Reductions of litmus in 2 and 3, slower in growth, are not complete till five days. The photograph shows the darker color of these tubes which have varied but little from the control.

FERMENTATION REACTIONS IN SACCHAROSE BOUILLON.

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the mucous membrane of the duodenum in its upper 8 cm. was deeply congested, showing punctate hemorrhages, and the whole bowel and serosa over it were œdematous. The duodenal papilla was swollen and prominent and had two bright punctate points of hemorrhage on it.

Stained preparations of all the organs, bile and urine showed myriads of bacilli.

Cultures showed a pure septicæmia as follows: Heart-blood, spleen, kidney, liver, and gall-bladder, *B. ent.* (Gärtner), pure culture; duodenum and urine, *B. ent.* (Gärtner), and *B. coli com.* and an unidentified bacillus.

Sections of liver showed hepatic cells greatly swollen and having undergone a fatty change. No focal necroses.

BLACK AND WHITE RABBIT. Same weight.

Previously immunized to *B. typhosus*.

Preliminary serum reactions.

B. typh. 1-2000 positive.

B. ent. 1-10 positive and suggestive to 1-100.

Aug. 30. Corresponding inoculation. (Cf. WHITE RABBIT I, Aug. 30.)

Aug. 31. Lively.

Sept. 5. Died 3 P. M. Immediate autopsy. Blood taken just before death shows an agglutinative reac. toward *B. ent.* of 1-500. *Macroscop. lesions.* Liver pale, soft, showing small yellowish areas of apparent necrosis.

Gall-bladder greatly distended, thin-walled and transparent. Contents thin and watery with an abundant mucoid yellow precipitate showing through the walls. Stained preparations from this fluid show masses of bacteria, chiefly in clumps, and desquamated epithelial cells. No motile bacilli seen on hanging drop.

Duodenum negative. A few slightly injected points. Other organs were mac. negative.

Cultures. Heart-blood, sterile; spleen, few colonies of *B. Gärtner*; kidney, sterile; liver, few colonies of *B. Gärtner*; gall-bladder, multitude of colonies of *B. typhosus*, an unidentified Bac. and *B. ent.* (?).

Duodenum. *B. pyocyaneus*, *B. coli com.*, unidentified bac. peptonizing milk.

Sections of liver show large areas of focal necrosis similar to those seen in WHITE RABBIT I.

From these last experiments we see that the normal control rabbit died of an acute general infection from *Bac. Enteritidis* with the usual characteristic lesions, especially referable to the eliminative system, namely, of the liver, gall-bladder and duodenum, from which organisms were obtained in greatest numbers. The rabbit (WHITE RABBIT I), which had apparently recovered from its infections with *Bacillus O* and *B. cholerae suis*, was killed at the same time, and it was found that no bacteria remained or could be found in the general circulation or organs, but an organism persisted in the gall-bladder which could be identified by serum reactions and was shown to be that of the most recent infection, namely, *B. enteritidis*.

The "typhoid" rabbit succumbed to his infection in six days with the characteristic lesions found after fatal inoculations with *B. chol. suis*, *B. icteroides* or other members of the group which are actively pathogenic. Necroses of the liver similar to those seen in this animal were found in WHITE RABBIT I when killed, and were probably due to the hog cholera rather than to the more recent Gärtner infection, as the control rabbit would have exhibited them.

These observations are too few in number to lead to any broad conclusions. They, nevertheless, are very suggestive of the possibility that immunization with one of these forms endows the animal with a certain degree of resistance toward infection with the others. Furthermore, an acquired serum reaction toward one form does not furnish agglutinative properties of equal degree toward other varieties even though they are so closely related as to be culturally indistinguishable. Thus agglutinative sera for individual forms may be obtained, by which means alone we can differentiate the organisms.

IN REVIEW.

A consideration of the cultural properties of the organism, *Bacillus O*, which has been dwelt upon at such length, demonstrates its close relationship to the definite and hardly recognized group of bacilli of the hog cholera or *B. enteritidis* of Gärtner type, which bacilli, having some characteristics peculiar to both the typhoid and colon groups, may be said to occupy a biological position intermediate to them. Whether the cultural characteristics of these organisms are but temporarily acquired, and whether they should merely be regarded as having a transient intermediary existence, may be a question of dispute; but, nevertheless, a certain distinct isolability for these particular forms is demonstrable, and the definiteness of the serum reactions, pathogenicity, and perpetuation of cultural features justifies their installment in a separate group.*

The elaborate tables of Germano and Maurea,³⁵ of Tavel and Lanz, of Gilbert, Booker, Smith and others show what a variety of closely related bacillary forms of this family may be isolated from one source or another. In a recent study of the intestinal flora of dogs, Dr. Livingood and the writer † isolated about fifteen varieties of bacilli, chiefly of the colon and paracolon type, though several more intermediate forms were found, and on not a few occasions organisms indistinguishable from *B. typhosus*. It can thus be readily understood, if typical or allied forms of these various groups occupy at one time or another the alimentary tract, that during the course of fevers associated with intestinal lesions they may easily find their way into the portal circulation and cause an infection superimposed on that of the original disease. It has been shown, however, that colon, which is a permanent inhabitant of the lower intestine where these lesions are usually situated and consequently the most frequent secondary invader, is rarely found in infections beyond the confines of

* Cf. Flexner, Simon. Microorganisms. Twentieth Century Practice of Medicine, Vol. XVIII, p. 655, 1900.

³⁵ Germano and Maurea: Vergleichende Untersuchungen über Typhusbacillen und ähnliche Bakterien. Ziegler's Beiträge, Bd. XII, S. 495, 1893.

† Experimental and Surgical Notes upon the Bacteriology of the Upper Portion of the Intestinal Canal, etc. Contributions to the Science of Medicine, dedicated by his pupils to William H. Welch, p. 571, 1900.

the abdominal cavity. Gwyn's *paracolon* and *Bacillus O*, on the contrary, were isolated, one from the peripheral circulation and the other from a surface lesion, and consequently it is unlikely that they were secondary invaders. Furthermore, the patient's blood reacted strongly to these organisms and not to *B. typhosus*, and it is not improbable that they were the specific cause of the disease, which resembled clinically typhoid fever. For similar reasons the recovery of *B. icteroides* from the peripheral circulation of patients suffering with yellow fever would favor Sanarelli's view that it is the cause of a specific fever and not a secondary invader, as many are inclined to believe.

The individuals of this group of organisms spoken of as an intermediate group present a wide range of pathogenic activity toward man and animals, and though they can be distinguished by their response toward various specific sera, they are practically identical in their cultural reactions. Their chief distinguishing features from *B. coli* and *B. typhosus* may be given as follows:

Chief distinguishing features of the Eberth or typhoid, Gärtner or intermediate and Escherich or colon groups.

B. typhosus. An actively motile bacillus possessing as many as 14 flagella at times and having marked pathogenicity toward man though slight toward the lower animals. Reaction in milk is acid, with a very late (months) or no terminal alkalinity. The organism ferments glucose but not lactose and produces no gas from any carbohydrate medium. Under ordinary conditions of isolation there is no production of indol.

Fermentation reactions:				
	Dextrose.	Lactose.	Saccharose.	
Total gas	0	0	0	
Aërobic:	Acid	Alkaline	Alkaline	
Reactions:				
Anaërobic:	Acid	Neutral	Neutral	

Intermediate Group. B. Gärtner and *B. chol. suis* type. Bacilli with the morphology of *B. typhosus* and possessing an equal or greater number of flagellæ. Actively motile and in many cases having a distinct pathogenicity for both man and animals. Reaction in milk presents an early and terminal strong alkalinity in the presence of air, appearing after transient acidity. Milk is never coagulated. They ferment glucose, with the production of gas, never lactose or saccharose. Under ordinary cultural conditions no indol is produced.

Fermentation reactions:				
	Dextrose.	Lactose.	Saccharose.	
Total gas	1/2	0	0 or bubbles	
H/CO ₂	2/1	0	0	
Aërobic:	Acid	Alkaline	Alkaline	
Reactions:				
Anaërobic:	Acid	Neutral	Neutral	

Bacillus O and *B. paracolon* (Gwyn) may represent a subdivision of this group, being slower in their action on milk and growing less luxuriantly and more like *B. typhosus* in various fluid media and resembling it in their pathogenic action on animals.

B. coli and its many allied forms. A bacillus with sluggish motility possessing few flagellæ. Pathogenicity ordinarily is slight for man and animals. Growth on potato abundant and colored. No alkalization in aërobic growth. Reaction in milk is acid, invariably sufficient for coagulation. It ordinarily produces a large amount of indol. It ferments glucose and lactose. Saccharose may or may not be acted upon.

Fermentation reactions:					
	Dextrose.	Lactose.	Saccharose.		
			var. (a)	var. (b)	
Total gas	1/2	1/2	0	2/3 slow	
H/CO ₂	2/1	2/1	0	3/2	
Aërobic:	Acid	Acid	Alkaline	Acid	
Reactions:					
Anaërobic:	Acid	Acid	Alkaline	Acid	

CHARLES FREDERICK WIESENTHAL, MEDICINÆ PRACTICUS, THE FATHER OF THE MEDICAL PROFESSION OF BALTIMORE.*

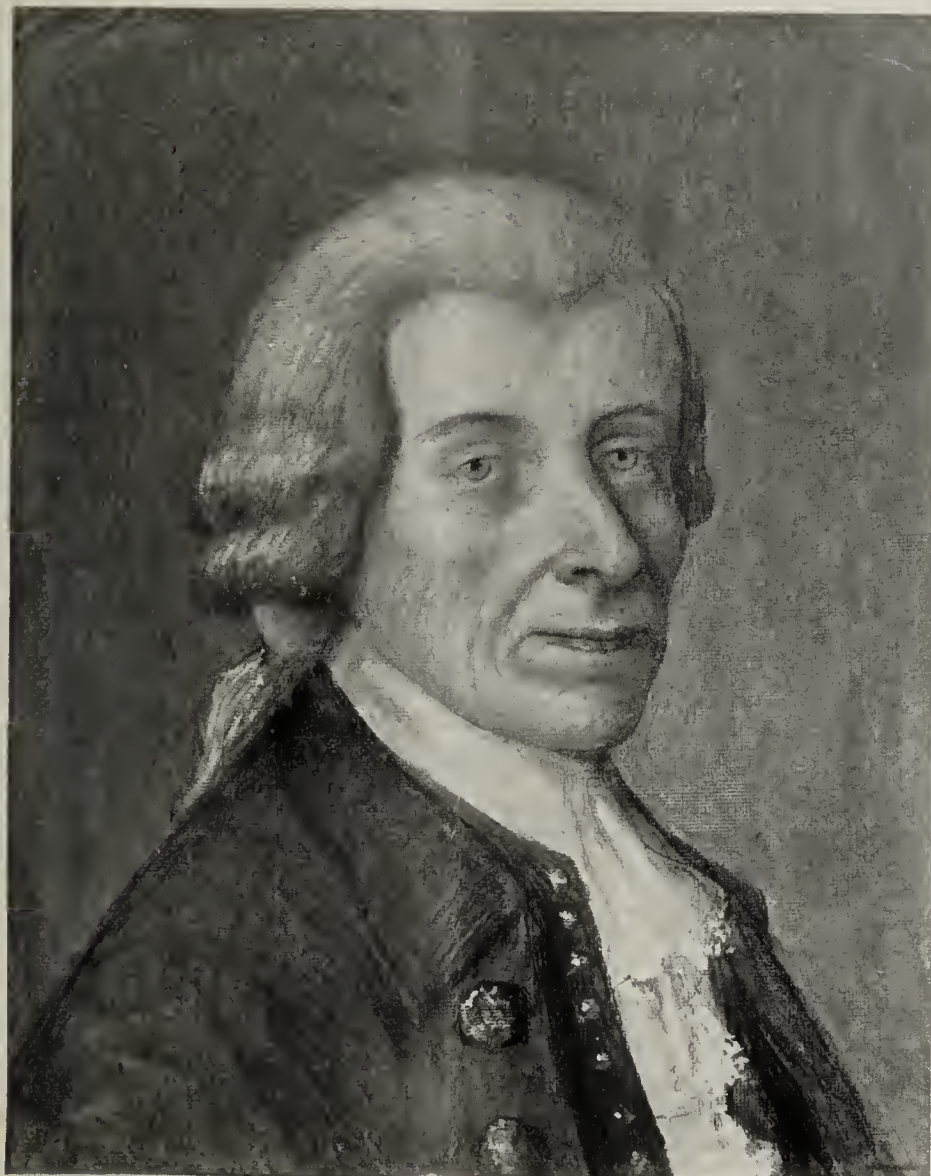
BY EUGENE F. CORDELL, M. D.

The first name of any importance in the medical history of Baltimore is that of Charles Frederick Wiesenthal, who was born in Prussia in 1726 and who settled in Baltimore in 1755. Family tradition asserts that he was "physician to Frederick the Great," but we possess no further details of his life in his native land. His familiarity with the organization of the medical department of the Prussian army, shown in his letters to the Maryland authorities during our Revolutionary War, lends some plausibility to the supposition that he may

have been connected with that service during his early professional life. There is evidence to show that his family enjoyed a good social position, and his educational advantages must have been considerable.

It is uncertain whether he possessed a medical degree or not. Dr. Ezekiel John Dorsey, a pupil, in dedicating a thesis to him (Edinb., 1776) adds M. D. to his name, while another pupil, Dr. George Buchanan, in a similar dedication (Phila., 1789) gives the name only without title. He does not appear ever to have used the degree himself, and in the account of the establishment of the first Lutheran church

* Read before the Johns Hopkins Historical Club, Feb. 12, 1900.



CHARLES F. WIESENTHAL.

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Baltimore, drawn up it is believed by himself, he is referred to as "Karl Fried. Wiesenthal, *Medicinæ Practicus*." He makes no allusion to the subject in any of his letters, not even in that urging upon Andrew the importance of a decree.

There were not many inducements for an aspiring young physician in "Baltimore Town," when Dr. Wiesenthal settled there at the age of 29. It was then but a small village of some hundreds of inhabitants, with unpaved streets, with but one church and without a newspaper. Its chief thoroughfare, "Long," now Baltimore, St., was in a wretched condition—indeed at times impassible. Within five years certainly it had been enclosed by a picket fence and gates to protect it from Indians. Annapolis, on the other hand (where Upton Cott had settled two years before) was the seat of government, the centre of the fashion, influence and culture of the province. But Baltimore, under the guiding genius of her "Romulus," as he was called—Dr. John Stevenson, a north Irishman—was even then looming up as the commercial metropolis of the state and it may be that he foresaw the future greatness which awaited it. Or he may have emigrated with a party of his countrymen, who selected Baltimore for a home, and from whom he was unwilling to be separated. Furthermore the country around was well settled and many of the landed proprietors were men of means, and able to compensate a physician liberally for his services.*

The summer that he arrived was signalized by the defeat of Braddock's army, an event that favored the growth of the town by deterring settlers from going westward. Shortly after his coming he married a lady of York, Pa., who bore him one son and three daughters. In 1771, he became naturalized. During the Revolution, he warmly espoused the cause of the patriots and his services and advice were of the greatest value to the state and country. In January, 1775, he was made a member of the Committee of Observation of Baltimore County and in December of the same year he received the appointment of superintendent of the manufacture of saltpetre for the state. In one of his letters he describes a journey made to some caves on the south branch of the Potomac, where an abundant supply of saltpetre was found. He published his method of manufacture of this substance in the Maryland Gazette, January 2d, 1776. On March 2d, 1776,† he was commissioned by the Council as Surgeon-Major of the 1st Maryland Battalion commanded by Col. Smallwood. In a letter to the Council of Safety, written at this time and still extant, he expresses his willingness to assist the cause to the extent of his power, strength and abilities and to go with the troops wherever they should be ordered. On the 14th of March, 1776, he published an appeal to the public

"for linen rags & old sheeting for bandages." In the same year he was Medical Purveyor for the Maryland troops and Examiner of candidates for medical positions in the Service. In 1777, according to Quinan he was Surgeon-General of the Maryland troops, in which position he received a salary of "35 shillings a day & no rations." Dr. Wiesenthal does not appear to have served with the troops in the field, although he visited them in an official capacity in their camps. He seems to have had the general supervision of medical affairs in Baltimore, establishing and conducting a hospital, purchasing medical stores and instruments, examining candidates and rendering professional services to the soldiers and sailors in the service of the state at this point.

According to Mrs. M. E. Reigart, of Baltimore, his granddaughter (who is here present this evening), Dr. Wiesenthal resided first in the suburbs of the town in a stone house on the Clifton Road, which is still standing. At what time he moved to his Gay Street house does not appear, but there he lived for many years, occupying two adjoining 2½ story dwellings, the one to the north as a dwelling house, and the other as an office.* These houses were demolished about 25 years ago and a large shoe store was built on their site. The lot extended through from Gay to Frederick Street, and on the rear of it Dr. Wiesenthal erected buildings for his medical school and dissecting room. In these, which are still standing, he taught many students, among whom were Drs. William Augustus Dashiell, George Buchanan, Ezekiel John Dorsey, Andrew Wiesenthal and Frederick Dalcho.† In one of

* Southeast corner of Gay and Fayette Streets, now Hill's Shoe Store. Fayette Street was not opened east of Gay until about 50 years ago, so that there was no corner there in Dr. Wiesenthal's day.

† Frederick Dalcho was born in London in 1770, his mother being Elizabeth Wiesenthal, a sister of Dr. C. F. Wiesenthal, and his father a distinguished officer under Frederick the Great, who having been severely wounded in battle had been permitted to retire to England for his health. Upon the death of his father, at the invitation of his uncle, young Dalcho came to Baltimore to prepare for the profession of medicine. He arrived in Baltimore in a sailing vessel on the 23d of May, 1787, "after a boisterous passage of 8 weeks." Here he obtained a good classical education, after which he devoted himself successfully to medical study including an extensive course of botany. He is said to have taken the degree of M. D. (his name is not included in the Catalogue of graduates of the University of Penna., but that catalogue is known to be very defective), and then to have obtained a commission in the medical department of the U. S. A. While stationed at Charleston, S. C., some difficulty arose between him and his fellow officers and he resigned (1799). He then entered on practice in Charleston and assisted in the establishment of a Botanic Garden. In 1807 he became coeditor of the Charleston Courier. He was also a very influential member of the Masonic body and later their Grand Chaplain. By request he published a work upon masonry which was adopted by the Order as an authority. In 1811 he became much interested in theology and a lay reader in the Episcopal Church. He was ordained Deacon in 1814 and Priest in 1818. In 1819 he was elected assistant minister of St. Michael's Church, Charleston, and continued with fidelity and acceptance to discharge the

* Gov. Sharpe reports, May 2, 1754, that the town has the appearance of the most prosperous one in the Province. Few, he says, except Germans, who are commonly the possessors of small sums of money, have settled and built in it. Letter quoted in *Trans. German Histor. Soc. of Md., 4th Ann. Report*.

† Quinan's Annals.

his letters (June 5, 1787) he speaks of the dissection of a little negro boy which young Dalcho was at that moment engaged in making. It must have been here, too, that the body of the murderer Cassidy was being dissected in 1788 when the mob collected and put a forcible end to the procedure.*

Dr. Wiesenthal was a zealous Christian and it was largely through his efforts and liberality that the first Lutheran church was built in Baltimore.† He was also President and Physician to the German Society (1784).‡

Dr. Wiesenthal was not only a public-spirited and useful citizen, but he was also a learned and skilful physician; devoted to his profession and ever seeking to promote its highest interests. His letters to his son Andrew, who studied first in Philadelphia (1781-2) and later in London (1786-9), designed for his son's eye alone, display the purity of his character and the loftiness of his motives. They contain also many interesting items, advice and allusions upon which I shall proceed to draw in further illustration of my subject.§ In the first of the series dated Dec. 25, 1781, he says: "We receivd your Letters . . . in which I see your beginning to dissect yourself which pleases me and I insist that you continue to do the same manually in *propria persona*, and not being content with merely demonstrations after the Subject is prepar'd, as

duties of that position until declining health compelled him to seek repose. His vestry declined his offer of resignation but gave him an indefinite leave of absence with continuance of his salary. He died Nov., 24, 1836, aged 76. His principal work was a history of the P. E. Church in S. C. during the colonial period, which is considered an authority upon that subject. He wrote other religious works, sermons and essays, and edited a church paper. A monument was erected over his grave by the vestry of the church. He was about 5½ feet high and well proportioned. His manners were genial, his intellect vigorous and well cultivated and he was a general favorite in the community. See *Annals of American Episcopal Pulpit*. By Wm. B. Sprague, N. Y. 1859.

* Griffith's Annals.

† This church stood on the south side of "Fish" (Saratoga) St., near "Bridge" (Gay) St., and near the site of the present Bethel African M. E. Church. The first building was erected in 1762 and was an unpretentious wooden structure used also as a schoolhouse. It stood on a high and steep hill. About 1771 the excavations for streets in the vicinity, made the building insecure and shortly after it was pulled down, the material sold and the hill leveled. A brick building was erected on the same site (Quinan says in 1773). "After twelve years," to provide further accommodations for the growing congregation, an addition was made to it. The late Rev. Dr. H. Scheib recollected this ugly structure with its organ. It was entered by a high stairway at the side. In 1808 it was sold to the African church and a large church was built on ground further to the north, the present Zion Independent Lutheran Church. Dr. W. was a liberal contributor to the early church; he was an elder of the congregation and his name comes always at the head of the lists of members. See *The Zion Church of the City of Baltimore*, by Rev. H. Scheib, 2d Ann. Rept. Germ. Hist. Soc. of Md.

‡ Quinan, *op. cit.*

§ They are closely written in a fine, neat hand. They are closely copied in the extracts here given.

I want the practical part. it will lead you towards Operations and will make that part of Surgery more intelligible. I hope you will not be content with merely knowing the Situation of the Viscera, but will examine them minutely, the contents Vessels Ducts &c." . . . "I hear Doctor Shippen has a young Gentleman who prepares the Subjects for his Demonstration I would have you cultivate a strict friendship as far as his Morals will admit of (in which particular you know my firm Opinion) and frequently make Inquiries of the Doctor himself, who I hope is often with you himself & teaches."

In Dec., 1787, he expresses his satisfaction at Andrew's predilection for surgery, "in which the Quack must starve aside, whereas in Physic in this part of the World the most errant Quack if he has Assurance enough will often claim the preference & obtain it before the Man of real and true Abilities."

Here, from the first letter, is an allusion to Dr. Thomas Bond, of Philadelphia, the founder of the Pennsylvania Hospital and the first clinical lecturer in America: "I am glad you have introduc'd yourself to Doctor Bond though he may have some Oddities, you may nevertheless rely on this that his Acquaintance will be valuable to you both his Learning and Experience are unquestionable, and he moreover is very communicative and takes a Delight in instructing young Persons and that in proportion to their Diligence and Application you will therefore visit his Lectures frequently and freely apply to him to resolve Such things as may be obscure to you, he is a good Surgeon besides and may give you Some good hints in the hospital."

There are but few allusions to cases and operations. "Mr. Yates . . . was formerly to become a Surgeon but has quitted it . . . but although he quitted Surgery that did not quench him, he having a fistula in Ano and undergoing an operation in London unsuccessful he came over to Maryland and recommended to me by Governor Smallwood. I laid it open very extensively, and found it proceeding near the root of the perineum up to that region between the bladder and the Rectum as well as along the Anus and to the Ischium where I was even apprehensive of a Caries, he having once had a Caries on the Tibia and lost a large Exfoliation, it moreover enters the Rectum as he says he has found some Excrements pass through the Wound and frequently flatus." . . . "I had last Summer a Child 4 Months old of Mr Willm Buchanan's under my Care whose head bulged out and distended every Suture it was taken with Convulsions. it was cured by applying blisters to the Spots for Some Weeks." He sends the report of a case in which "the quantity of matter issuing from a tumor no bigger than a walnut was nearly 3 pints." In Sept., 1788 he writes: "Mr Wolsenhome from St Mary's City was this Morning with me for my Advice he came but lately from London has formerly had my Opinion in writing concerning some nervous Symptoms deriv'd from the Gout. he has consulted several eminent Physicians in London especially Letsome & Heberden. he show'd this Letter I mean Heberden my Opinion in writing concerning the Complaint

treatment which being approv'd of by the Doctor furnished me little Stoff for my Vanity." In an earlier letter to the Council of Safety (*Md. Archives*, Dec. 8, 1776) to which my attention has been called by Dr. Jackson Piper, he describes a curious case of "Eresypelas" in a soldier, due to taking cold, and involving the entire body "from head to foot," "the Vesications common in that Disorder displaying a humour so sharp that in a few days he was all over deprivd of his skin." He had likewise lost his eyesight and his life had been saved with the utmost difficulty. The doctor regarded the blindness as incurable. He advises Andrew to study to become skilful in surgical operations especially lithotomy and "extraction" of cataract. He refers to the great success of Dr. Tyler, a young physician of Frederick who had made considerable reputation in "couching the cataract." He tells him to study closely the action of drugs and to make himself acquainted with all new discoveries.

He was very anxious for Andrew to take a degree and expresses regret that the latter had not gone to Edinburgh to study instead of to London. He longs to see something in print "over the name of A. Wiesenthal that may meet the approbation of the learned." He asks what is to be the theme of his inaugural essay? in what language shall it appear? Is he sufficiently master of the Latin to hold a public disputation? In Leyden, at least, a public disputation is not demanded—perhaps at Rheims the same is the case. Would that he were with him to assist with advice and counsel! He sends A. from time to time copious notes of cases and opinions on various medical subjects, which he urges him to put into shape for a thesis or for publication in some journal. Oct. 1787, he writes: "I have sent you various Cases in Physic and will consider of some more, and I think I will likewise send you some of my Theoretical Opinions which you may be probably able to elaborate something farther and could it be worth the Notice of some of your friends it might be perhaps worth while to have it published, for this Truth that a great many more silly things have been published than what we should." In Nov., 1788, he tells him that a diploma is indispensable and suggests that he might obtain one in some institution without residence, or an honorary one. "Doct. Brown the great opposer to Dr Cullen's Doctrine and who now resides in London and as common Reporter even in the Fleet's prison where he lectures, has wrote me a young Students Thesis on which he obtained his Diploma blindfold."

The substantials of life are not forgotten. The Christmas letter of 1781 already spoken of concludes: "We congratulate you to these Christmas holidays and wish you had one of our very good min'ed pyes." In Oct., 1787, he sends Andrew a box of "hommany Beans & Sweetmeats." In another letter: "Mr. Yates sails on the Willing Tom next Week and I hope he will be able to take the Geese with him but I am almost afraid we are too late. Mama I apprehend by wanting to extend her bounties will be the Cause of your getting none." The next day—in a postscript—"My Suggest-

tions are but too true, the Willing Tom is sailing from Patowmack and the smoaking the Geese requiring a little more [time] lay till at last the S(c)hooner saild from Annapolis by which all remaining Stores were sent and Mr Yates going by Land obligd us to postpone it to another Opportunity which we hope will soon happen."

Dr. W. was very anxious to have a law passed for the regulation of medical practice in the state and headed a movement with that object in view. The prevalence of quackery, the low standard of medical training and the reprehensible conduct of many physicians in good standing, made an organization of the profession and a regulation a necessity. On Sept. 12, 1788, he writes thus: "To rescue the Dignity of Physic from that horrid State into which it is plungd within these few years and most especially since my Sickness will require a Herculean Labour, and it will fall in some Misure to your Lot to undertake the laborious Task." After a full and public discussion of the matter in the town paper, a meeting was called for Nov. 27, 1788, the call being signed by himself. At this meeting which was most probably held at his house, he was chosen chairman. There is mention of it in a letter dated Nov. 28, 1788: "We are just about procuring a Medical Regulation in a little more earnest than heretofore, it nevertheless meets with some underhand jealousy and what amazes me it comes from Doct. B . . . we have had 3 meetings he has had allway^s written Invitations and each Time evaded it. The reason we only guess at. Last Nights meeting it was proposed for the Sake of Order and to have jointly more Weight to organize ourselves into a Society under Rules. I was unanimously nominated President and Mr Frederick for Clark, so that he has now an office." The plan which was then framed embraced the entire state in its operations and was similar in its features to the Charter of the Medical and Chirurgical Faculty adopted eleven years later. But for Dr. Wiesenthal's ill-health and death the following spring, there is little doubt that he and his associates would have succeeded in their object, and thus have anticipated by ten years the founding of the Medical and Chirurgical Faculty.

Dr. Wiesenthal almost idolized his son Andrew—his only son. His letters abound with the most endearing expressions, as this: "so tender a father as I am who makes his Sons welfare his only happiness in this World," and he lavished his money freely in giving him the best opportunities then available for education. In Sept., 1788, he estimates that he has supplied Andrew with nearly £450 sterling—"a pretty Modest Sum in these dreadful Times," he adds. Moreover we must remember that Andrew lived with his aunt during his stay in London, and that the above amount did not include his books, instruments, medicines and the passage money home, which were still to be provided. He chides him mildly on one or two occasions and refers to a letter of A.'s headed "*sans six sous*," which seems to have worried him a great deal.

The following pathetic passage occurs in a letter of No-

vember 28, 1788: "I for my part am already disordered and laid up like an old Man of Warship. although the Shafts of Jealousy are still continued to be let off against me as if they dreaded my returning to my usual Strength again nay I verily believe, they will hate my very Memory ten Years after my having returned to Dust, and be afraid and Jealous of me (horrid indeed!) if I reflect that at all Times I have acted up to the Dignity of the Profession, have disdained all mean Empirical Methods, because I had no Occasion I think that I ought to be respected as a father and Supporter of the Profession and be treated friendly." In another letter about the same time he writes: "I find no remedy now in the late Evening of my Life as to prostrate myself before the Throne of the Almighty and expect in the other World that which this has denied me."

Towards the last, Dr. Wiesenthal, who was of a highly nervous temperament, suffered greatly from hypochondria. Every circumstance became irksome to him and he sought and found relief from his despondency in the tinctura thebaica which he supplemented with the liquor anodynus Hoffmanni. The dose which he took of the former was not extreme, not exceeding, according to his statement, 40 to 45 drops.

His last letters show that he was failing. Sept. 12, 1788, he writes: "My health, my dear son, is very precarious and being in my grand Climacteric, the 63d year of my Age I find myself declining every day." Although he lingered on to the spring of 1789, his eager longing to see his son before he died was not gratified. There is something inexpressibly sad to see this good old father sinking into the grave, hoping day by day for the return of his son beyond the sea and with his life lit up by that one thought alone.

The following is the notice of Dr. Wiesenthal's death taken from the *Maryland Journal and Baltimore Advertiser* of June 2, 1789: "The shaft he so often warded from others has pierced him at last. Yesterday morning about half past seven o'clock departed this life Dr. Charles Frederick Wiesenthal, in the 63d year of his age after having practiced in this town for 34 years. If the strictest attention in his profession which humanity could excite & that success which might be expected from superior medical abilities improved in an uncommon measure by reason & observation deserve to be remembered, the tears of gratitude must flow in sorrowful profusion. HE IS GONE! & the pain of reflection is the more heightened because it is at the time when he was in daily expectation of the return of an absent & only son whose virtues & abilities are beloved & admired by all who know him."

Dr. Wiesenthal's picture suggests a large, fine looking dignified man with a German type of countenance. He was generous and hospitable and particularly kind to the poor,

often remitting his charges against them when they seemed unable to meet them.* His dress is described as follows: "scarlet cloak, three cornered hat, blue velvet coat with gold buttons & buff facings, buff vest, lace ruffled shirt, knee breeches, stockings, shoe buckles, plain white cravat surrounding neck, wig & cue tied with a black ribbon." He was the first physician in Baltimore to drive a four-wheeled carriage. On this was inscribed his crest & motto—horse's head bridled & bitted with two crossed arrows beneath & the words Premium Virtutis."

Dr. Wiesenthal's remains were interred in the burial ground attached to the church, but were afterwards removed to Loudon Park Cemetery. No tombstone was ever erected over them. Andrew died in 1798, at the early age of 36, leaving a son Thomas Van Dyke Wiesenthal, who became a surgeon in the U. S. N. There is only one person now living bearing the name of Wiesenthal, an aged single lady residing in Boston, but whose present residence we have not been able to find.

One of Dr. Wiesenthal's pupils in dedicating his graduation thesis to him, speaks of his "great professional skill, his rare & singular virtues & his nobility of character";† another compares his position in Baltimore to that of Sydenham in London.‡ I venture to think that after what we have heard this evening we shall not consider him unworthy of the further title—one which he so much coveted—"Father of the Medical Profession of Baltimore."

[In connection with the above paper, there were shown a pencil portrait, drawn by his son Andrew, his crest and motto and a photograph of his medical school, still standing.]

Authorities consulted:

Letters of Dr. C. F. Wiesenthal, MS.

Quinan's Annals.

Maryland Archives.

Newspapers of Baltimore and Annapolis.

Griffith's Annals.

Rev. Dr. H. Scheib's Article (Germ. Histor. Soc. Pubs.).

Family Tradition (Mrs. M. E. Reigart).

* "When patients came to settle bills, if poor, he would look in his books and say: 'I don't find anything against you.'"—Mrs. Reigart.

† *Dissertatio Inauguralis de Nutritione*. Ezekiel John Dorse, Edinb., 1776.

‡ *Vir Venerabilis, Carolus Fredericus Wiesenthal, rei medicae apud Baltimoreenses cultor felicissimus, qui ob magnam omnium quoque medicinam spectant, notitiam, non minoris ibi quam Sydenhami olim apud Britannos fuit aestimatus, penditur*. Inaugural Thesis of Dr. George Buchanan. Univ. Pa., 1789.

THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice, abstracts of papers read, and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

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Dr. Wiesenthal's Medical School, the first established in Baltimore. We do not know when it was opened, but there are grounds for conjecturing that it was between 1760 and 1770. In February, 1774, Dr. W. A. Dashiell defends the views of his preceptor (C. F. W.) in the newspaper, a controversy having arisen between the latter and Dr. Ephraim Howard, concerning the use of venesection in a case of pneumonia, and in his inaugural thesis at the University of Edinburgh, 1776, Dr. E. J. Dorsey speaks of Dr. W. as having taught him the elements of medicine. The view was taken from a second-story window of house northeast corner of Frederick and Fayette streets, and one is looking a little south of west. The street before is Fayette, between Gay and Frederick. In the distance one sees over the tops of the houses, the cross of Church of the Messiah (P. E., on Gay Street). In the centre of the square is the long two-story schoolhouse containing the sign "Hill's Hand-made Shoes". The smaller two-story building, at the nearer end of the square, also stood in Dr. W.'s day, and is believed to have been his dissecting-room. At the further corner of the square is Hill's shoe-store, built about twenty-five years ago, on the site of Dr. W.'s residence. Fayette street, formerly "East Street," was not opened between Gay and Frederick until about fifty years ago, and the doors and windows of the school-house on that side must have been made at that time. The stone steps at the side used to be at the front entrance. The old lady is Mrs. Reigart, granddaughter, and the young gentleman to the left, at the edge of the pavement, is Mr. John Milton Griffith, great-great-grandson of Dr. W. Mrs. Reigart lives at 216 Girard avenue, and is 82 years of age. Behind them is the writer of this sketch. After his father's death in 1789, Andrew taught here until his death, in 1798. Shortly after the latter event, the house, which was then 40 N. Gay Street, passed out of the possession of the family. It is now unoccupied. About fifty years ago it was used by Mr. McMullan (who is still living) as a furniture storeroom. Mrs. Reigart is the daughter of Julianna Susanowa Wiewsky Wiesenthal, "the mischievous little Julianna, the pretty little babbler," of the letters, born four years before Dr. W.'s death and named after her godmother, Countess Beneowsky, sister of Mr. Messonnier, the importing merchant of Baltimore, who married Dr. W.'s daughter Elizabeth. We are absolutely certain that there was no mistake, the writer took Mrs. R. (who is a very intelligent person, with senses and faculties all good) to the premises, which we inspected thoroughly. Although she never lived there, she has perfect recollection of the place, which she has often described before. She says that her mother's nurse—a white woman—lived to an advanced age, and often talked to her of her grandfather and his family, and pointed to the building as her grandfather's school. There is, therefore, no question about its identity.

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PRIMARY CARCINOMA OF THE APPENDIX VERMIFORMIS; II. CARCINOMA OF THE APPENDIX SECONDARY TO CARCINOMA OF THE OVARIES.

BY ELIZABETH HURDON, M. D.,

Assistant in Gynecology, Johns Hopkins University.

New growths of the vermiform appendix are so unusual and hitherto have received so little attention that each case is worthy of being recorded. The following cases, one of primary origin, the other secondary to an ovarian tumor, have recently occurred in the service of Dr. Kelly, to whom I am indebted for the privilege of making this report. Apart from its rarity the first case is of interest on account of the early age in which it was discovered owing to the routine examination of the abdominal viscera made in all cases of abdominal affection. The second case was also detected by this general examination.

In the literature there are references to ten cases of carcinoma originating in this organ. Of these, however, only the three cases in which the diagnosis was confirmed by a microscopic examination can be accepted as well established. These were shown to be of the usual type of carcinoma of the testis. In two cases the growth had penetrated the abdominal walls appearing externally as large crater-like ulcers with thick irregular margins.

In Thiersch's case, reported by Bejer, the extension had taken place along a sinus which had persisted for three and one-half years after the opening of a large pus-sac in the right iliac fossa. On partly removing the external mass a finger-like cord was disclosed which extended down into the peritoneal cavity. This proved to be the vermiform appendix, and in the cecum a tumor the size of a walnut could be felt surrounding the orifice of the appendix.

The writer calls especial attention to the early formation of adhesions and infiltration of the abdominal wall and to the absence of intestinal symptoms. He is of the opinion that the growth began in the apex of the appendix and slowly extended along the mucosa to the cecum.

In the case described by Kolaczek the right lumbar region presented a deep ulceration, at the base of which was the dead os ilii. At autopsy the appendix was found to be destroyed by a tumor which had invaded the walls of the cecum, and also the surrounding cellular tissue and the psoas muscle.

Morse and Daumie report a case occurring in a woman 50 years old who had died of heart-disease. The vermiform appendix floated free in the peritoneal cavity, was 4 cm. long, 4.5 cm. in circumference and cylindrical in shape. On transverse section the muscular layers could be seen enclosing a hard mass within which was a narrow canal opening into the cecum. The tumor did not project at all into the cecum and was limited to the appendix. Histological examination showed the muscular coats for the most part normal, but in places separated by small islands of epithelial cells. The peritoneal coat was normal. In the central part of the tumor and in the canal were seen remains of the mucosa and of Lieber-

kühn's glands. The latter had for the most part undergone cancerous transformation and were probably the origin of the neoplasm. No other growth was found.

Carcinomata occurring in the vermiform appendix are of the two varieties commonly observed in growths affecting the alimentary canal, namely, colloid carcinoma and adenocarcinoma with glands resembling proliferating glands of Lieberkühn. An unusually large proportion of the cases occurring in the appendix if we accept the diagnosis made from the gross specimen are of the colloid type.

The clinical notes on the present case are briefly as follows:

Gyn. No. 6646. Mrs. G. Age 24. Married 9 years. II para. The oldest child 8 years, the youngest 3 years old. 2 miscarriages, the first six years ago, the last in August, '98. Her family history is unimportant, with the exception that one brother died at the age of 18 after amputation of the leg for a "cancer."

The patient had always enjoyed excellent health until the birth of her first child. At varying intervals thereafter she suffered pain in the lower part of the abdomen and back. The pain was described as aching or dragging in character and was most severe the week preceding and following menstruation. Last spring the patient had a fall and afterwards the pain which previously had been limited to the pelvis became more marked higher up in the right iliac fossa and was associated with constant aching in the right lumbar region. This was ascribed by her physician to a floating kidney which was found to be present. Her appetite failed and at times she suffered from nausea and vomiting.

On palpation the abdomen was non-resistant, and there was no tenderness in either iliac fossa. The right kidney was palpable and slightly movable; on bimanual examination the uterus was found in acute retroflexion and its mobility was restricted. Further examination was negative.

Operation by Dr. Kelly, Feb. 21st, 1899. Release of pelvic adhesions; suspension of the uterus; removal of the vermiform appendix.

The uterus was found retroflexed and bound down by a few light adhesions. The tubes also presented a few adhesions somewhat stronger on the right than on the left side. Apart from these adhesions the tubes were perfectly normal and no cause for the pelvic peritonitis could be discovered until on looking for the appendix it was found hanging down into the pelvis over the right infundibulo-pelvic ligament and enveloped in dense vascular adhesions. A shortened mesentery caused the outer third to redouble on the inner portion, and at the point of flexion there appeared to be a foreign body in the canal.

The appendix was amputated close to the cecum, the uterus

and tubes freed from adhesions and the uterus suspended. The abdomen was then closed in the usual way.

The patient made an uneventful recovery and was discharged March 16th. In a letter written Dec., '99, she stated that she had gained twenty-three pounds and her general health was excellent. She suffered, however, from some discomfort in the right lumbar region, probably owing to the movable kidney.

Pathological report: Gyn. path. No. 2854. The appendix is 10 cm. long. At the junction of the middle with the outer third it is slightly flexed and held in this position by broad velamentous adhesions. The proximal end is practically normal but the part beyond the flexion is distended, having a diameter of 12 mm. and contains a soft concretion of about the size and shape of a date-stone. The walls here are thinned, averaging not more than 1 mm. Their internal surface is smooth. Joining the distended extremity to the normal inner half of the appendix is an intermediary portion about 1.5 cm. long, of firm consistency. Previous to removal this was supposed to contain a concretion but on transverse section it is seen that the lumen is practically obliterated by a small oval swelling which impinges upon the canal so that merely a small crescentic slit remains. This is displaced toward the inferior border of the appendix by the tumor which encroaches from above. To the naked eye this minute tumor appears to be about 1 cm. long, and 5 mm. in its greatest thickness. Its cut surface presents a whitish dense appearance and is partly homogeneous, partly finely striated. It is enclosed by the muscular coats into which its external margin imperceptibly merges.

HISTOLOGICAL EXAMINATION.—In a transverse section through the portion of the appendix occupied by the new growth it is seen that all its coats to a greater or less extent are infiltrated with epithelial cells in the form of nests or cylinder-like processes. The muscular coats are not thickened and the epithelial processes which here are slender and cord-like invade the interstitial connective tissue while the muscle bundles remain unaffected. The epithelial proliferation is most evident in the mucous and submucous layers, which are markedly thickened, forming a rounded prominence which encroaches upon the central canal. The cells in this portion are arranged in oval or irregular masses, or in parallel columns consisting of three, four or more rows of cells. The intervening stroma is scanty and indeed the epithelial masses are sometimes directly contiguous. In the center of the column of cells a narrow central canal is sometimes faintly visible, and in the larger masses the cells are now and then seen to be disposed in little circles which may present a minute central lumen. Extending downward from the surface of the mucosa there are a few normal glands of Lieberkühn. Others which are found here and there between the cancer nests show beginning proliferation and alteration of the character of the epithelial cells and are undergoing early carcinomatous changes. The starting point of

the growth has probably been in the area included between points p. and c., Figure 2, as here all the glands have been replaced by masses of tumor cells.

The surface epithelium of the mucosa has not taken part in the tumor-formation and is intact, though where the growth impinges upon the canal the cells are flattened. The mucosa lining the opposite side is attenuated and its glands shallow and few in number but the epithelial cells exhibit no tendency to become proliferated and are unaltered in appearance. The lymph-nodes have disappeared. The submucosa is scanty. Both circular and longitudinal muscular coats are of normal thickness.

On higher magnification the tumor-cells are seen to be fairly uniform, the peripheral layer of the nests consisting of low columnar, the central mass of oval cells. Where the minute lumina are present in the cell masses they are also lined with low columnar cells. The cell nuclei are oval or spherical and are vesicular. Their chromatin is finely granular. There are, however, various large cells containing deeply stained hyperchromatic nuclei which are coarsely granular. Mitotic figures exhibiting the different stages of cell-division are moderately numerous.

The invasion of the muscular and peritoneal coats is associated with but little inflammatory reaction, but the mucous and submucous layers show a marked leucocytic infiltration and it is noteworthy that a considerable proportion of the infiltrating cells are eosinophiles.

In the superior segment of the appendix, that is, the portion farthest from the mesenteric attachment, the growth has penetrated all its coats extending to the peritoneum, which contains many large round or oval cell-nests, d. Fig. 2, but the inferior segment has apparently been invaded only in the circular muscular tunic where a few strands of epithelium extend almost entirely around, running parallel with the muscle fibers.

The various coats of the cystic extremity of the appendix though thinned out preserve their normal proportions. Its inner surface is smooth and even, and its epithelial lining intact. The glands are diminished in number and shallow but otherwise unaltered; the stroma scanty and the lymph follicles atrophic and widely separated from one another.

The cecal half of the diverticulum is normal in all respects.

The first cause of the formation of carcinoma affecting any organ remains to be discovered, but the presence in this case of the fecal matter suggests an important question as to the etiological significance of foreign bodies in the development of tumors. The occurrence of new growths of the bile-passages and kidneys with calculi intimately associated has frequently been observed and a few tumors of the appendix have been described which had developed around foreign bodies as their centers. An instance described by Lafforgue is a small lipoma situated in the wall of the appendix which contains a small concretion in its center.

Gilford reported a case of sarcoma surrounding a concretion in the appendix, the growth having apparently resulted from



FIG. 1. Primary carcinoma of the appendix. The position and caliber of the canal are indicated by the dotted lines beginning at *a* and extending to the apex. *d* shows the dilated extremity. Between *b* and *c* is an indurated portion gradually merging into the normal.

The flexion is not so acute as before cutting the mesentery.

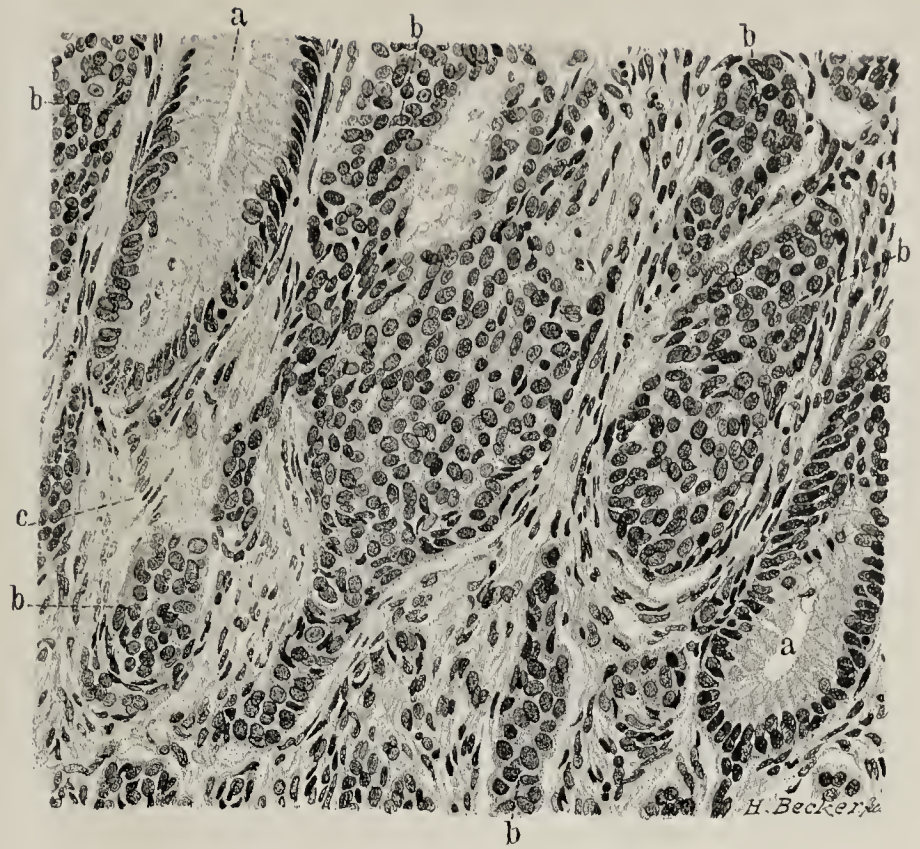


FIG. 3. A higher magnification of a small area in Fig. 2, carcinoma of the appendix (350 diameters). Two glands of Lieberkühn are seen at *a*, and masses of carcinoma cells at *b*; *c* indicates the stroma.

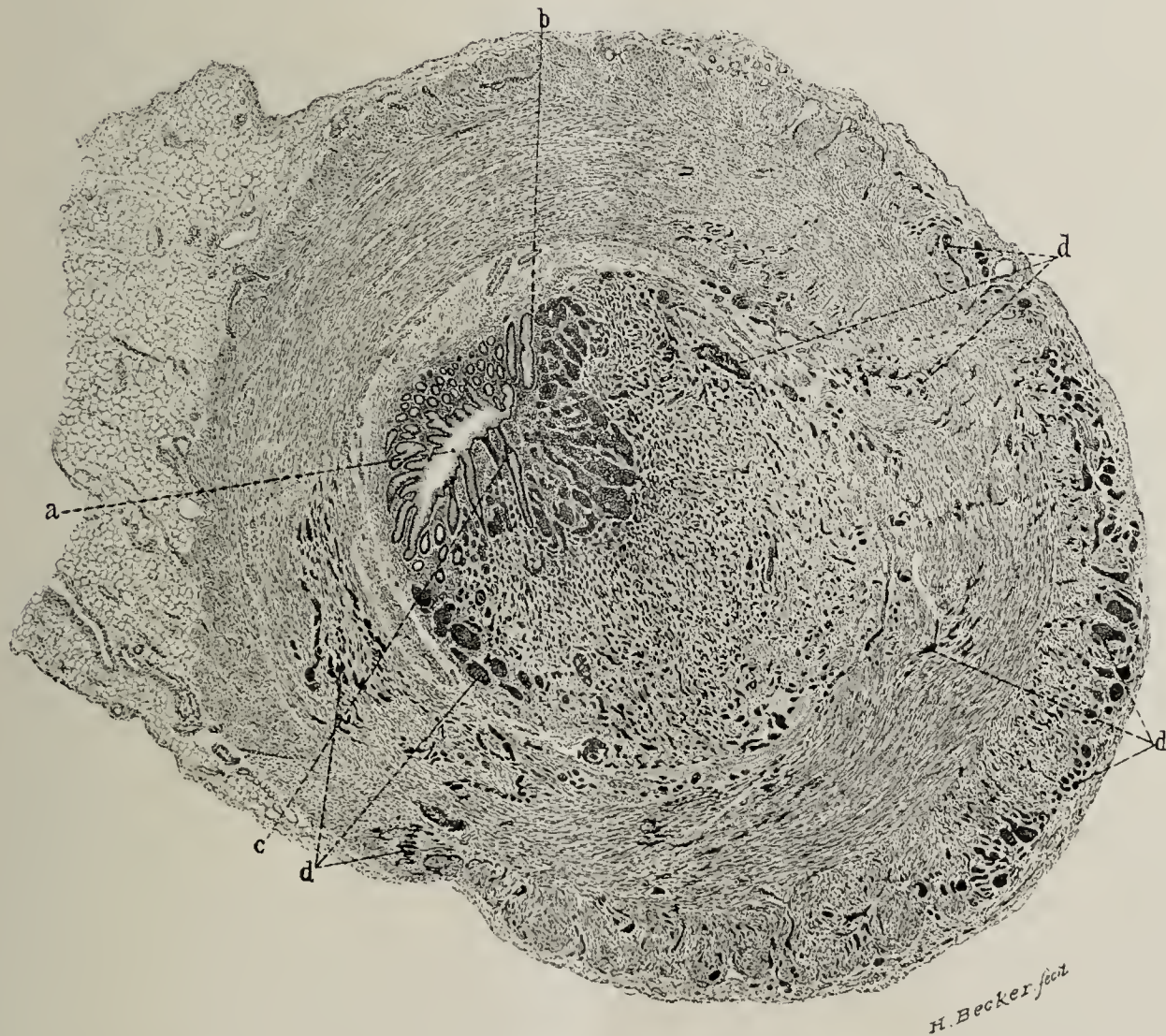


FIG. 2. Transverse section of carcinoma of the appendix (15 diameters). The canal of the appendix is seen at *a*. On the left side the mucosa and submucosa are practically normal; a few strands of deeply stained tumor cells are present in the circular muscular coat; the longitudinal muscle and mesentery are normal. On the right between *b* and *c* the glands of Lieberkühn have been replaced by the neoplasm, and islands of tumor cells, *d*, are scattered throughout the remaining coats.

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previous appendicitis. The tumor was removed with a portion of ileum and colon to which it was adherent and the patient made a good recovery. On cutting open the tumor three or four small collections of pus were laid open and in one near the middle of the mass was a fecal concretion twice the size of a cherry-stone. A probe passed into this cavity passed down the appendix vermiformis into the cecum. The microscope showed principally large oval and spindle-shaped cells, and the growth was considered to be an undoubted sarcoma. A small nodule was also excised from the right psoas. In the cases of carcinoma of the appendix reported in the literature one writer mentions that a fecal concretion was present in the dilated extremity, the growth in this case affecting the cecal end. In our case the foreign matter is of softish consistency and there is no evidence of irritation of the epithelium lining the canal at any point. It is conceivable, however, that the presence of the body with the impossibility of expulsion due to the kink has in some way incited the atypical glandular proliferation.

Several of the cases quoted gave histories of attacks of acute appendicitis occurring some years before the discovery of the cancer.

DIAGNOSIS.—The difficulty of diagnosis in carcinoma of the appendix is indicated in the histories of the cases quoted above and is owing to the absence of distinctive symptoms in the early stages. Our attention is first directed to the iliac region by the onset of pain and the presence of tumefaction, and when these are manifest the growth is usually well advanced. As a rule there is no interference with the digestive function until the growth has invaded the cecum or the large or small intestine. This was observed in only two cases late in the course of the disease. The most constant symptom is the presence of a dull pain of a not severe type affecting the right iliac region and extending to the right groin and thigh. On making a physical examination a firm mass is found occupying the position of the appendix vermiformis. This is usually cylindrical and before adhesions have formed is freely movable within a limited radius. The appendix, however, may be small and nodulated as in the cases of scirrhous carcinoma and is then hardly to be distinguished from a calculous appendix. The diseases for which carcinoma of the appendix is most apt to be mistaken are: cyst of the appendix, calculi, tuberculosis of the so-called neoplastic form, impacted feces in the cecum or small intestine. Floating kidney was diagnosed in the case of sarcoma of the appendix recorded by Gilford.

In many instances only an exploratory section will enable one to make a positive diagnosis.

PROGNOSIS.—If we should consider the prognosis of carcinoma of the vermiform appendix from the standpoint of the outcome in the cases reported it would be rendered extremely grave. It must be remembered, however, that the majority of these cases were observed in an early time and before the period in which operative interference began to be so gener-

ally employed. Moreover in one case death was due entirely to an intercurrent affection and in three other cases we do not know that the growth was in any way responsible for the fatal termination. On the other hand, however, the absence of functional symptoms and the little pain excited by the presence of the growth may cause it to be overlooked until the surrounding tissue has been invaded or until rupture occurs, and in the latter case the ensuing general peritonitis is itself attended with serious consequences. In the present time when the vague pains accompanying mild affections of the appendix are more carefully investigated and when operative interference is more generally employed for the relief of such cases the prognosis in carcinoma is rendered more favorable as it is for this class of cases that early carcinoma is liable to be mistaken.

TREATMENT.—There is little to be added regarding the treatment in cases of carcinoma, as when the symptoms or the results of the physical examination warrant the assumption that the appendix is diseased, the safest course is to perform an exploratory section, and if the suspicion is verified, to remove the appendix. If the appendix is found to be the seat of a new growth in order to insure its complete removal the head of the colon should be resected and should the growth have visibly extended beyond the appendix a more extensive resection may be indicated. In cases still further advanced and involving the abdominal fasciæ a radical cure can scarcely be expected and the patient receives little benefit from an incomplete removal of the tumor.

SECONDARY CARCINOMA OF THE APPENDIX.—Secondary carcinoma of the appendix is of interest chiefly from the scientific standpoint, since clinically, as it gives rise to no symptoms or to none that are characteristic, its presence is masked by the primary tumor. Moreover, if detected its removal does little to stay the progress of the disease. Metastatic carcinomatous growths in the appendix appear to be almost as rare as the primary cases, most of the secondary growths consisting of direct extensions from the cecum. The most frequent seat of the original tumor appears to be in the ovaries, the stomach or other portion of the digestive tract, or the uterus. The growth in the appendix corresponds in structure to the original tumor.

The case I have to report was discovered at operation for removal of a large ovarian tumor, and at the same time it was found that the pyloric end of the stomach was also the seat of a new growth.

Gyn. No. 5262. Mrs. S., age 57 years, was admitted to the gynecological service complaining of an abdominal tumor associated with some pain in the lower abdomen and a slight sanious discharge of about six months' duration. She was a healthy-looking woman, her appetite was good but she suffered from slight indigestion and chronic constipation. Further than this her history is unimportant.

Operation by Dr. Kelly.—Removal of both ovaries and tubes and the vermiform appendix.

The left ovary was transformed into a large oval tumor of remarkably dense structure. On microscopic examination this was found to consist of small round or oval glands imbedded in a dense cellular connective-tissue stroma. The glands were lined with low columnar or flattened epithelial cells with protoplasm stained deeply with eosin and containing large nuclei of variable shape and intensity of color. The epithelium was mostly disposed in one layer but occasionally two or three layers were seen.

The remaining pelvic organs appeared normal with the exception that the mesosalpinx of each side was thickened and the peritoneal surfaces of the broad ligaments and uterus were studded with a few small flat white nodules. One of these was excised and examined under the microscope showing only fibrous tissue but doubtless further sections would have revealed their carcinomatous nature. Microscopic examination of the right ovary showed that though not enlarged it was also invaded by the new growth which was limited to two well-defined areas immediately beneath the albuginea, and a small area in the hilus.

The vermiform appendix was found to be thickened, nodular and very rigid in its outer half, the cecal half being normal. The mesenterium was indurated. On cutting open the appendix its outer third was found to be slightly distended, containing a small fecal concretion. Internally to this there is a nodular enlargement 1 cm. in diameter formed by the general thickening of all its coats. The lumen here is constricted. The proximal half is of normal caliber.

Histologically, excepting in the thickened median portion of the appendix, nothing of importance is noticed. At this point there is a marked hyperplasia of the lymphoid ele-

ments of the mucosa and submucosa and on the side to which the mesentery is attached the peritoneal, muscular and submucous layers are infiltrated with a carcinomatous growth similar to that in the ovary, while here and there in the muscular coats generally are small islands of carcinoma cells sometimes contained in vessels, but whether lymph channels or veins is not determined. A few light adhesions are attached to the surface of the appendix, and in one of these there is a small nest of carcinoma cells. The mesenterium is also invaded by the growth chiefly in its outer half.

In this case it is probable that the carcinoma cells were carried through the peritoneal lymph spaces to the mesenterium and thereupon invaded the various coats of the appendix. This view is maintained by the occurrence of the few superficial nodules distributed over the peritoneum which are probably metastatic, as the main tumor is enveloped in a smooth fibrous capsule and not apt to give rise to implantation growths, and from the fact that the principal focus of invasion is at a point contiguous to the mesentery, which is also extensively involved in its corresponding portion.

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A CASE OF TRANSIENT SPASTIC CONVERGENT STRABISMUS.

BY SAMUEL THEOBALD, M. D.,

Clinical Professor of Ophthalmology and Otology, Johns Hopkins University; Ophthalmic and Aural Surgeon to The Johns Hopkins Hospital, Baltimore.

Spastic convergent strabismus, or strabismus from tonic spasm of the internal recti muscles, a condition to be sharply differentiated from ordinary concomitant convergent squint and from squint due to paralysis of the abductors, is one of the well-recognized ocular manifestations of hysteria; but, apart from this, it would seem, deserves to be regarded as a rare anomaly, to which, as a rule, the text-books upon diseases of the eye devote but scant attention.

De Schweinitz, in the paragraph of less than five lines which he devotes to "spastic strabismus," † says that it "occurs only under rare circumstances in hysteria and brain dis-

ease (meningitis). It is difficult of diagnosis, periodical concomitant squint in hypermetropia being sometimes inaccurately described as due to spasm of the internal rectus (Mauthner)." Jackson, in a paragraph of equal brevity, says "deviations of the eyes due to spasm of the ocular muscles attend hysterical seizures and some forms of brain-disease. They may assist in the general diagnosis, but have little localizing value, and require no treatment apart from that of their cause." *

Fuchs, though he states that "tonic spasms of the ocular muscles are extremely rare," adds that "many cases of intermittent strabismus belong under this head," and he mentions two cases of this character which he had observed in

* A paper read before the American Ophthalmological Society, May 3, 1900.

† Diseases of the Eye, third edition, p. 554.

* Diseases of the Eye, p. 234.

hysterical women.* Roosa says children, in whom optic neuritis is found to be present, are often brought to ophthalmic clinics with strabismus in its early stages which is non-paralytic. "Every careful observer," he adds, "will take great pains to determine in a given case of suddenly occurring strabismus, that there is not some cerebral lesion. During convalescence, certain children are apt to squint." This, he thinks, "may fairly be ascribed to cerebral irritation." † Quane, in his chapter upon "movements of the eyeballs and their anomalies," in De Schweinitz and Randall's American Text-Book of Diseases of the Eye, Ear, Throat and Nose (p. 11), treating of parietic and spastic squint, says "spasm, which is much less frequent than paralysis, is due to irritative causes (meningitis, etc.), chorea, epilepsy, and hysteria; rarely is idiopathic." Noyes, Norris and Oliver, Fick, Nettleship and Swanzy, so far as revealed by a glance through their respective treatises upon diseases of the eye, make no mention of the subject of spastic strabismus.

In Norris and Oliver's System of Diseases of the Eye, Partridge, treating of the ocular manifestations of hysteria, considers at some length the "anomalies of convergence" occurring in this condition. If we would understand the anomalies of the movements of the eyes in hysteria, we must, he says, consider that neither muscles nor nerves, but nerve centers, and, indeed, the higher centers, are affected—those whereby the movements themselves are brought into unison with psychic action"; and, he adds, "another fact connected with a study of hysterical disorders of the ocular apparatus is that they are almost always of the nature of contractures, even when they present the objective characteristics of paralysis." ‡ In the same volume (pp. 708 and 710), Santos-Fernandez, treating of the "ocular manifestations in influenza," mentions cases of paralysis of the third and sixth nerves and of "convergent strabismus" as having been observed in this affection, while Culver, in the chapter upon "Anomalies of the motor apparatus of the Eye," says "Changes in the centers of innervation as primary causes of strabismus are admissible only in certain definite cases," and, again, "Convergent strabismus may be due also to a *spasm of convergence*, independently of accommodation and refraction. We have observed cases of this kind in hysteria. It is perfectly admissible that the same phenomenon is produced in consequence of other irritations of the center of convergence." §

Briefly described, the case which I wish to report is as follows:

A little girl, seven years of age, convalescing from a pronounced attack of influenza, a marked feature of which had been persistent and severe headache, and during the course of which an otitis media had developed in the right ear, complained of diplopia, and on the following day exhibited an intermittent squint. At the request of the attending physician,

Dr. W. D. Booker, I saw the case on the second or third day after the squint manifested itself.

There was present at this time, in both distant and near vision, a very decided convergent squint of the left eye. There were no signs of paresis of either rectus externus—each eye could be rotated outward farther than is commonly possible, and neither the extent of the squint nor the diplopia was influenced by the direction in which the head or the eyes were turned. The pupils were of normal size and there were no signs of either paralysis or spasm of the ciliary muscles. The ophthalmoscope revealed a hypermetropia of rather more than 2 D., and, as I had previously performed a tenotomy upon the little patient's mother for a pronounced esophoria, I concluded that the influenza had been the straw which had broken the camel's back, and developed a concomitant squint in a child who had, probably, inherited insufficiency of the external recti muscles and who was decidedly hypermetropic. That the trouble would be overcome without glasses or an operation seemed to me highly improbable. Dr. Booker had already prescribed iron and quinine and a nourishing diet, and the general condition of the patient was improving from day to day.

At my second visit, four days later, although the mother reported that the eyes had been straight at times during this interval (?), I found the squint unchanged except that it showed, perhaps, a greater tendency to alternate. Thinking that suppression of the accommodation might favorably influence the squint, I directed a two-grain solution of atropia to be dropped into the eyes twice a day. Two days subsequently, the eyes being thoroughly under the influence of the atropia, the squint seemed somewhat less marked. My next visit was five days after this, and, to my gratification, I then found no trace of the squint remaining. Not only so, but even with the cover test it showed no disposition to recur, and an esophoria for distance of only four degrees was shown by the Maddox rod. A decided change for the better in the general condition of the patient was also evident.

After another interval of four days, the eyes meantime having remained quite straight, the atropia was discontinued, although, I confess, I still had serious misgivings as to what would occur when the ciliary muscles began to regain their activity. However, my apprehension proved to be groundless, for a week elapsed without any recurrence of the squint, by which time she had recovered her power of accommodation sufficiently to be able to read ordinary print. The Maddox rod now showed an esophoria for distance of only 3°, while, more noteworthy still, the vertical diplopia test showed at 12" a so-called exophoria of 4°—a practically normal muscle balance. Since then the eyes have given no further trouble.

A few days since (April 26th), nearly two months having elapsed since the disappearance of the squint, the muscle balance was tested with the following result:

Esophoria 20' = 1°	} Rod test.
No hyperphoria 20'	
Exophoria 12" = 1° (Vertical diplopia test).	

*Text-Book of Ophthalmology, p. 576.

†Diseases of the Eye, p. 553.

‡Vol. IV, p. 754.

§Op. cit., p. 100.

That the squint in this case was a purely spastic one, due, doubtless, to an irritation (of influenzal origin) of the innervation center which controls the associated action of the internal recti muscles, is, in my judgment, not open to question. Had it been a concomitant squint, precipitated by the attack of influenza, as I at first supposed, it might, indeed, have disappeared under the influence of the atropia and with the improvement in the patient's general condition; but, under such circumstances, a normal muscle balance would certainly not have been reëstablished in the space of a few days, as actually happened. On the contrary, a marked, and probably persistent, esophoria would certainly have been encountered.

As to abductor paresis, I have already said there were no signs whatever pointing in this direction; but, apart from this

fact, the rapid return of the lateral muscles to a condition of practical orthophoria, is as little consistent with this view of the case as it is with the view that the squint was a concomitant one.

An incomplete search through the literature of the subject has revealed only one case which bears a close resemblance to my own. In the Archives of Pediatrics, Vol. 1, p. 634, Dr. Samuel S. Adams, of Washington, reports an interesting case of convergent strabismus as a sequela of diphtheria, in which paresis of the external recti muscles was excluded, and which he attributed to "a spasm or over-action of the internal rectus" due to an irritation of the center of ocular adduction. The squint disappeared completely within a few days of its onset.

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American Laryngological Association. Transactions of the Twenty-first Annual Meeting held in the City of Chicago, Ill., May 22, 23, and 24, 1899. 8vo. 233 pages. 1900. D. Appleton and Company, New York.

Proceedings of the American Medico-Psychological Association at the Fifty-fifth Annual Meeting held in New York, May 23-26, 1899. 8vo. 437 pages. Published by the American Medico-Psychological Association.

Transactions of the American Pediatric Society. Eleventh Session held at Deer Park, June 27, 28 and 29, 1899. With the Constitution. Edited by Floyd M. Crandall, M. D. Volume XI. 1899. 8vo. 252 pages. Reprinted from the Archives of Pediatrics.

NOTES ON NEW BOOKS.

Surgical Pathology and Therapeutics. By JOHN COLLINS WARREN, M. D., LL. D., Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. Second edition. (Philadelphia: W. B. Saunders, 1900.)

The writings and reputation of the author of this much-esteemed book are sufficient to warrant a scientific, practical and very useful work on surgical pathology. His physiological and pathological knowledge combined with his great experience in teaching are evident throughout the book. These make it not only a valuable text-book but also a reference-book because of the thoughtful combination of physiological and pathological knowledge with a fairly extensive use of historical and biographical references. There is a great present need of this book, which will be a guide to workers and a model on which future writers may build—adding here and there a few innovations in methods, if not in materials.

The new edition differs from the first one only in the addition of a more extensive appendix which is designed to act as a clinical guide in working up surgical cases. It also contains what is not commonly found in surgical works—an article which will bring it into the hands of the dental surgeon. This is a very useful section on the bacteriology of the mouth and how to prepare for filling teeth.

Bacteriology may be considered completely treated when we get to the detailed work on bacteriological technique and surgical bacteria of the main body of the book, the appended bacteriology of the skin, pleura, joints, bladder, eye, ear and nose, and a paragraph on bacteriological examinations.

Omissions made in the original are supplied in the appendix. It was a notable oversight in the first edition not to speak of one of the most important of the surgical bacteria, the *Bacillus pyogenes Capsulatus* (Welch), and the omission of the *Gonococcus* as a cause of peritonitis. This has been rectified in the appendix and the *Pneumococcus* and *Typhoid bacillus* are given the scope as surgical bacteria.

A valuable introduction to the article on inflammation is given in Chap. III on Hyperæmia in which the relationship between physiology and pathology is clearly brought out.

The chapter on inflammation is a type of the work, being eminently practical and scientific. The references to works on the subject are full but not too extensive.

It is worthy of note that after reviewing so usefully and

thoroughly the writings of those most worthy of quotation the author ends his chapters with his own healthy view of the subject.

Infective inflammation is dealt with in three chapters. This differs from the simple form in that it is due to bacteria and spreads, usually ending in suppuration. The etiology is included with some practical points on invasion of tissues. Under the same head comes Acute Osteomyelitis with a very useful, complete description of the local action of the infective process. The various causative agents and their differences in action with the change in the part acted on are noteworthy. Repair is sharply separated from inflammation, as it should be. The nervous theory of shock gets greatest credit after a historical review of the subject.

In five chapters the author gives a clear portrayal of the fevers of surgery, the physiological basis preceding the pathological condition being first described. Traumatic, Aseptic and Urethral Fevers, Septicæmia, Pyæmia and Erysipelas come under this head. Tetanus is thoroughly treated of in a special chapter; its bacteriology and treatment by antitoxins being described in other chapters.

Tuberculosis of bone is well handled—the manifold pathological appearances and clinical pictures being given in a concise, yet complete manner. The experimental work stands forth prominently—Cheyne and Krause getting credit for much good work.

Under tuberculosis of joints Warren very properly adheres to Cheyne's view that there are two forms, one beginning in the joint, another being primary in the bone. In the treatment of abscesses the healing power of iodoform is asserted.

Chapter XXVI deals with tuberculosis of the soft parts, including the peritoneum, glands and genito-urinary tract. Diseases of bone have a special chapter and include all of the diseases not dealt with under the headings Osteomyelitis, Tuberculosis, and Tumors of Bone—there are many of them. Osteopsathyrosis, Senile Atrophy and Osteoporosis are said to denote closely allied conditions of bone, the absorption of the bone being due to "lacunar absorption." Neuroparalytic Atrophy, that due to the pressure of aneurisms and to malignant growths, is included under the heading Osteoporosis. Nearly all known diseases of bone are included in this chapter.

It is remarkable how the author has managed to include all the practical points of surgical pathology in some way, leaving out no important ones. If not found in their natural places they turn up somewhere else.

There is nothing of special note in the chapter on Tumors. The classification is the simplest possible. Endothelioma is classed with Carcinoma; yet, when writing about Sarcoma, it is shown how the endothelial tumors are closely related to them. The theories of tumor-formation are discussed, especially the parasitic theory, which still remains not proven.

In describing Sarcoma and Carcinoma each organ and locality of the body is taken up in order, with its peculiar tumor growths. The use of the Mixter punch in settling the question of malignancy of a new growth might be criticised.

Besides the surgical treatment of Carcinoma the author is not sure but that something may develop from the work on the injections of cancerin—extracted from cancer cells as recommended by Adamkiewicz.

A few drawings of macro- and micro-scopic aspects of tumors are given but no special merit is noted in the illustrations.

The appendix has been written to fill in what did not fit well in the main body of the book and to give the special bacteriology of various localities and organs.

It is well that it was added, if for no other reason than the addition of a useful article on peritonitis. The old edition only alludes to peritonitis of tubercular origin.

Here too are added certain good points on pathological technique and clinical microscopy and corrections are made of oversights in the main body of the book. Subjects not usually treated of in surgical text-books are here brought forward.

In the chapter on Scientific Aids to Surgical Diagnosis, which is a rather overcrowded article, after insisting that the surgeon should know enough of laboratory methods to be able to say which of them can give him positive results in case a specimen is sent for examination, he refers to some things to be learned from blood-examinations; gives some points in bacteriological technique, and speaks of the necessity for animal inoculation. In this chapter a great number of bacteriological data, urinary symptoms and findings are crowded together in marked contrast to the clearer writing of the original edition.

To the Röntgen rays is devoted a special article describing their value in detecting fractures, foreign bodies, calculi, etc. Their advantages and disadvantages are referred to, and several illustrations are added.

Chapter II deals with the surgical bacteriology of the skin, and treats of wound-infection and disinfectants in a brief and practical manner. Useful points in technique, such as the preparation of ligatures, of the patient, of instruments, of the surgeon, and the treatment of the wound, not included in the original are found here. Serum therapy is also dealt with in its relation to tuberculosis, tetanus, syphilis and streptococcus infections.

The contents of the whole volume are of the greatest value, and the matter is presented in a very interesting manner by one who is a master and teacher.

The Medical Annual and Practitioner's Index, 1900. (*J. Wright & Co., Bristol, and E. B. Treat & Co., New York.*)

The present number, the eighteenth of its publication, is well up to the standard of previous years. In recently noting the Synoptical Index of this work for the years 1887-1898 we commented on its valuable features. The extracts and notes of articles are usually well made, some of them giving the important points more clearly than they are given in the original articles. Special attention may be drawn to the section on Malarial Fever, by Major Ronald Ross. It gives an excellent short account of the recent work on that subject. Colonel Keith Hatch contributes an interesting article on Mycetoma which is well illustrated. To those who have used the Annual its good points are well known. It may be recommended to those who do not know it as being helpful in many ways.

Pye's Surgical Handicraft. Fourth edition, revised and enlarged, by BERTRAM ROGERS, M. D. (*John Wright & Co., Bristol, 1900.*)

It is a pleasure to see another edition of this work, eight years having elapsed since the third edition. It was first published by the late Mr. Pye, in 1884, and some words of his original preface regarding the title of the work may be quoted: "Although surgery is doubtless becoming more scientific day by day, nevertheless it will never cease to be a skilled labor nor will surgeons ever cease to be handicraftsmen." His object in the book was to describe the details of surgical work from the point of view of house surgeons and "dressers" in the surgical wards. With this purpose the work is thoroughly practical and the descriptions are plain and accurate. At the time when one is first battling with the many difficulties and emergencies that come to the young house officer, this book is a great help. There are few surgical conditions that are not described and the advice given is usually sound. Every senior student and young graduate will find this work useful. We speak with grateful remembrance of its assistance in days gone by when one dwelt

with the fear of an improperly treated emergency ever before his eyes.

Injuries to the Eye in their Medico-Legal Aspect, by S. BAUDRY, M. D., Professor in the Faculty of Medicine, University Lille, France; translated from the original by ALFRED JAMES OSTHEIMER, JR., M. D., of Philadelphia, Pa.; revised and edited by CHARLES A. OLIVER, A. M., M. D., Attending Surgeon to the Wills Eye Hospital, Ophthalmic Surgeon at the Philadelphia Hospital, Member of the American and French Ophthalmological Societies, etc., With an Adaptation of the Medico-Legal Chapter to the Courts of the United States of America, by CHARLES SINKLER, Esq., Member of the Philadelphia Bar. (*Philadelphia, New York, Chicago, The F. A. Davis Company, Publishers, 1900, pp. X-161. Price \$1.*)

It is not long since that we had the pleasure of perusing another of Prof. Baudry's contributions, "Simulated Blindness." The System of Diseases of the Eye, by Norris and Oliver (Vol. IV), and perhaps the Lille professor is best known to many of his American readers as one of the contributors to that standard work on ophthalmology.

American ophthalmologists seem to be less familiar nowadays than formerly with what is going on in the domain of French ophthalmology, a condition of affairs which is to be attributed to the fact that in this branch of medicine more than ever before inspiration is being drawn from Germany. We should not forget, however, what de Wecker, Panas, Landolt and Meyer have done and that they are still working at the very front.

The object of Professor Baudry's work is to equip the ophthalmologist with a medico-legal knowledge of injuries to the eye. It is surprising that ophthalmic literature is so poor in information of this character. The author has collected his personal observations and compiled the reports and published conclusions of others upon this subject. It is a short work consisting of scarcely one hundred and fifty pages and is full of practical information. The contents will not strike one as being something which is entirely new, for the clinical facts, at least, which every page is full, are all old stories and form part of the mental equipment of every experienced ophthalmologist. The book will be useful, however, because it contains the clinical facts condensed and so arranged as to form what may be regarded as a distinct and important chapter in ophthalmology, "Eye Injuries." It is needless to say that such a presentation of the subject leaves a clear impression.

In its application to the legal status or value of an injury to the eye it is to be hoped that the work will be found useful, though we doubt whether it can be regarded as a preeminent valuable guide to the expert in estimating accurately the damage caused by the injury to the individual. Such a work, we think ought to contain more clinical records with the legal points to which they give rise, and should be illustrated by pertinent cases with their legal conclusions or decisions.

It is divided into four parts: 1. "Traumatic Lesions of the Ocular Adnexa." 2. "Traumatic Lesions of the Eyeballs." 3. "Simulated or Exaggerated Affections of the Eye." 4. "Medico-Legal Expert Testimony."

We look upon Part Third, which treats of a theme on which Baudry is a recognized authority, as the best in the book; it is, from a medico-legal point of view. Professor Jacquemont, of Lille, has contributed the legal portion of the last chapter, which is to the point and is an epitome of the principles which govern opinion-evidence and will be found to contain what every practitioner of medicine should know.

In conclusion we are happy to bear witness to the readiness of Doctor Ostheimer's translation and to this further to the industry of Doctor Oliver, the editor.

R. L. 1

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MORBID CONDITIONS CAUSED BY BACILLUS AËROGENES CAPSULATUS.

THE SHATTUCK LECTURE.¹

BY WILLIAM H. WELCH, M. D.,
Professor of Pathology, Johns Hopkins University.

CONTENTS.

Introduction.—Historical.—Nomenclature.—Characters of Bacillus Aërogenes Capsulatus.—Distribution.—Gas-Bubbles in the Blood and Organs.—Emphysema.—Gaseous Abscesses.—Uterine Infections: Emphysema of the foetus; puerperal endometritis; physometra; emphysema of the uterine wall; puerperal gas-sepsis.—Infections of the Urinary Tract.—Infections derived from the Gastro-intestinal Canal: Local gastro-intestinal lesions; pneumo-peritonitis with and without perforation; hepatic and biliary infections.—Interstitial Emphysema of the Gastro-intestinal, Genitourinary, and Biliary Tracts.—Pulmonary and Pleural Infections.—Bacillus Aërogenes Capsulatus in the Blood during Life.—Presence of Bacillus Aërogenes Capsulatus without Gas.—Meningitis.—Pyogenic Capacity of Bacillus Aërogenes Capsulatus.—Cavities in the Brain.

Although the subject which I have chosen for this lecture refers for the most part to infrequent affections, the scientific and practical interest attaching to them is considerable and widespread. Many instances of the presence of free gas in parts

of the body where it does not normally occur and in association with various diseases were recorded by writers of past centuries and were even then the subject of much speculation. The discussion turned generally around the question whether the gas was atmospheric air or the result of putrefaction—a question which in most cases could be solved only by bacteriological examinations. The most numerous and important of such examinations have been made during the last decade, and, although these have left problems still unsolved, they have corrected many current errors and have shed a flood of light upon conditions which were formerly among the most mysterious in pathology.

While it has been demonstrated that various bacteria may be concerned in producing gaseous affections, it is now evident that the bacillus which I discovered in 1891, and to which I gave the name Bacillus aërogenes capsulatus, is the one whose causative agency is best established and most frequently in action. What I shall say will relate mainly to this micro-organism and its pathogenic effects.

Historical.—As a certain amount of confusion concerning

Delivered before the Massachusetts Medical Society, June 12,

the dates of the first publications² on this bacillus exists in foreign literature on this subject, it may be well to state that I reported my observations in November, 1891, to the Johns Hopkins Hospital Medical Society and that the full report of these observations and of the characters of the bacillus was published in July-August, 1892, by Dr. Nuttall and myself.³ E. Fraenkel's first publication⁴ was a short preliminary one which appeared in January, 1893, and was followed in the same year by his valuable monograph on gaseous phlegmons.⁵ In August, 1893, one year after the publication of the paper by Nuttall and myself, appeared simultaneously the interesting articles of P. Ernst⁶ and of Graham, Steward and Baldwin⁷ on foamy organs. Early in 1894 Mann published from my laboratory an observation of emphysematous gangrene caused by *Bacillus aërogenes capsulatus*,⁸ and in January, 1896, Dr. Flexner and I published an extensive paper reporting twenty-three human cases, including not only six personal observations of emphysematous gangrene but also examples of submucous gas-cysts, pneumoscrosis, and various other pathogenic manifestations of this bacillus.⁹ In July, 1895, appeared Goebel's preliminary communication,¹⁰ and in the following year his full paper on the bacillus of foamy organs.¹¹ Of the subsequent records the most numerous and valuable have appeared in this country, although they appear to be little known to most European writers.¹² I shall have occasion

² Levy's description in 1891 (*Deutsche Ztschr. f. Chirurg.*, XXXII) of "kleine, feine" bacilli, cultivated from a gaseous abscess and growing in long threads and chains only at body temperature and cultivable only in the first generation, without animal experiments, cannot be accepted as an identification of *B. aërog. capsulatus*, or indeed be readily reconciled with its characters.

³ Bulletin of the Johns Hopkins Hospital, 1892, III, p. 81.

⁴ *Centralbl. f. Bakter.*, XIII, p. 13.

⁵ *Ueber Gasphlegmonen.* Hamburg u. Leipzig, 1893.

⁶ *Virchow's Archiv*, CXXXIII, p. 308.

⁷ *Columbus Med. Journ.*, XII, p. 55.

⁸ *Annals of Surgery*, XIX, p. 187.

⁹ *Journal of Experimental Medicine*, 1896, I, p. 5.

¹⁰ *Centralbl. f. allg. Path. u. path. Anat.*, VI, p. 465.

¹¹ *Jahrb. d. Hamburgischen Staatskrankenanstalten*, IV.

¹² Thus v. Hibler in 1899 (*Centralbl. f. Bakt.*, XXV, p. 513 et seq.), in an elaborate study of pathogenic anaërobes, is entirely ignorant of our work and that of other American investigators on *B. aërog. capsulatus*. The information of Hirschmann and Lindenthal (*Sitzungsber. d. k. Akad. d. Wiss., Math.-Naturw. Cl.*, Wien, 1899, CVIII, Heft 3, Abth. III, p. 67) on the American work is secondhand and both incomplete and inaccurate, in these respects being in unfavorable contrast to that of Muscatello, assisted by Gangitano (*Riforma Med.*, 1900, II, p. 508 et seq.), who write also on the subject of emphysematous gangrene. Knowledge of *Bacillus aërogenes capsulatus*, under the name "*Bacillus perfringens*" (Veillon and Zuber), has begun to appear in France in the last two years, but without evidence of acquaintance with the American publications. Even allowing for the great difficulties in keeping pace with the literature of any subject in medicine, a decade would certainly seem sufficient for the light to penetrate even into dark places.

to refer later to many of these publications, among which those of Dunham, Dobbin, Norris, Bloodgood, Howanitz, Nicholls, and Pratt and Fulton, may here be mentioned especially valuable.

Nomenclature.—Dr. Fraenkel has kindly favored me with cultures of the bacillus which he isolated from gaseous phlegmons and to which he gave the name "*Bacillus phlegmonis emphysematosæ*." There can be no question whatever but that his bacillus is identical with our *Bacillus aërogenes capsulatus*, a point upon which we are both agreed, and which is also made certain by Goebel's studies under Fraenkel's supervision. According to the generally accepted principles of the nomenclature of zoological and botanical species, the name "*Bacillus aërogenes capsulatus*," as being the first one applied, should be preferred to that of *Bacillus phlegmonis emphysematosæ*. It is, moreover, as pointed out by Muscatello, not open to the objection of implying exclusive relationship to a single disease, as is the case with Fraenkel's designation of the bacillus. As a matter of fact, as we shall see, the capacity to produce gaseous phlegmons is only one of many pathogenic manifestations of *Bacillus aërogenes capsulatus*. Unfortunately I think that we both erred against the canons of botanical nomenclature in using a trinomial rather than a binomial name for a species.¹³

Characters of Bacillus.—Since our first publication only a material addition has been made to the extended description given by Welch and Nuttall of the morphological and cultural characters of *Bacillus aërogenes capsulatus* or the gas-bacillus as I shall briefly call it.¹⁴ Fraenkel noted the presence of spores in a few of the bacilli growing in one lot of agar containing sodium formate, and in 1897 Dunham¹⁵ observed spores, with all of the specimens studied, in blood-serum cultures, but not in other media.

Our further studies of the gas-bacillus obtained from different sources have shown a moderate range of variation in some of its properties. This is true especially of spore-formation, rapidity of liquefaction of gelatine, presence of capsules and virulence.

¹³ Migula, who, with considerable success, has attempted to reform bacteriological nomenclature, has given the binomial name "*Bacterium Welchii*" to *Bacillus aërogenes capsulatus* and "*Bacterium emphysematosum*" to *Bacillus phlegmonis emphysematosæ* (*System der Bakterien*, II, pp. 392 and 383, Jena, 1900). He is, however, in error in describing this organism under two different names, as his *Bacterium Welchii* and *Bacterium emphysematosum* are identical.

¹⁴ As regards these characters it will suffice here to say that the microorganism is a rather coarse, non-motile, anaërobic bacillus, stains by Gram; grows on all of the ordinary culture-media under anaërobic conditions, best at body temperature, but also at room temperature; liquefies gelatine slowly; forms spores constantly according to the race and the culture-medium, and is capable of generating gas not only by fermentation of sugars but also from proteids. The full description of the characters may be found in Welch and Nuttall's paper.

¹⁵ Bulletin of the Johns Hopkins Hospital, 1897, VIII, p. 68.

While some specimens of the bacillus seem never to form spores on any culture-medium, others, and these appear to be the more common, do so occasionally, especially upon blood-serum, in mannite bouillon, and on plain agar. In animals inoculated with pure cultures we have not observed spore-bearing bacilli.

As a rule the bacillus liquefies gelatine slowly but some specimens do so scarcely at all, and others with fair rapidity. In our first communication we noted peptonization and softening of the gelatine, but this was so slow and slight with the particular specimen studied that we then preferred to class the bacillus among the non-liquefiers. Further experience has shown that the bacillus is a liquefier, but generally a slow one.

As stated in our original article, capsules are not constantly present, but I have generally found no difficulty in demonstrating them in the situations and by the method described by us, and, with the exception of Hirschmann and Lindenthal, most other investigators have been able to demonstrate capsules, when these are searched for by suitable methods.

While the bacillus is to be ranked among those which stain by Gram, it is sometimes rather noticeable in coverslips from cultures that among well stained bacilli, others are partly or wholly decolorized, and this may be observed in members of single chain. In the tissues the bacilli stain well by Gram. Differences in the viability of cultures were pointed out in our first paper.

It sometimes happens that original cultures from human beings show only a feeble growth, with relatively weak power of gas-production, while subsequent cultures, especially those obtained after passage through the animal body, present the usual vigorous growth and other typical characters. Pratt and Fulton,¹⁸ from a typical case of foamy organs with gas throughout the body, were unable to cultivate the bacillus at all, although twelve anaërobic culture tubes containing various media were inoculated from different parts of the body. This negative result they attribute to the fact that the body had lain in a cold storage vault for sixteen hours after death, an explanation which has some support in an observation previously reported by Welch and Flexner, but it seems hardly satisfactory, as under like conditions the bacillus has been often cultivated.

Lactose, glucose and saccharose are all fermented by the gas-bacillus, the first with the largest production of gas and the last with the smallest. The gas, according to Dunham's analyses, is composed approximately of 64 per cent hydrogen, 10 per cent carbon dioxide, and 8 per cent of a residual gas believed to be mainly nitrogen. It has no foul odor. The amount of hydrogen always greatly predominates over that of carbon dioxide. There is apparently no fermentation of mannite, at least the gas is not appreciably more than in carbon-free media.

2. Fraenkel in 1893 was the first to demonstrate the etiological relation of the gas-bacillus to gaseous phlegmons, our

previous investigations being concerned mainly with the so-called foamy organs (Schaumorgane) and the presence of gas in the blood, our results being confirmed a year later by P. Ernst. Soon after Fraenkel's publication we were able to confirm his discovery of the causation of gaseous phlegmons by *Bacillus aërogenes capsulatus*, and to repeat with like results his animal experiments.

Material or cultures fresh from the infected body are usually highly virulent for guinea-pigs, pigeons and sparrows (E. Fraenkel), which succumb to rapidly spreading local necrosis of the tissues with abundant development of gas, the bacilli invading the blood during life only in small numbers or not at all. There is more or less bloody œdema, but otherwise little inflammatory reaction, leukocytes being present usually only in small numbers in the exudate. Rabbits and mice, while not wholly immune, are far less susceptible than guinea-pigs and pigeons. Dr. Lanier in my laboratory in 1896 succeeded in producing typical gaseous phlegmons around the fractured bones of rabbits inoculated intravenously with pure cultures, and Muscatello has obtained the same results. There are considerable differences in the degree of virulence of the bacillus even in fresh cultures, and old ones may be of very slight virulence.

One of the most interesting and valuable tests of the gas-bacillus is its power of producing gas abundantly in the blood, organs and tissues of rabbits killed a few minutes after intravenous injection, a power not possessed by colon bacilli. The differential value of this test is as great as that of cultures in fermentation tubes. The blood and tissues of the dead rabbit make the culture-medium, the body of the animal takes the place of the test tube, the inoculation is an aseptic one, the bacteria are spread by the blood-current and the conditions are anaërobic. This procedure, which was introduced by Nuttall and myself and has been fully described by us, we have found useful under proper precautions in isolating the gas-bacillus, in separating it from other bacteria which may resemble it, and in the demonstration of one of its most fundamental characteristics, namely, the power to produce gas from proteid material.

Among the points distinguishing the bacillus of malignant œdema from *Bacillus aërogenes capsulatus* may be mentioned the following: The malignant œdema bacillus is somewhat thinner; has greater tendency to grow into filaments; is less readily stained by Gram; produces spores regularly in culture-media; is motile; liquefies gelatine much more rapidly; produces a foul odor; generates less gas in lactose bouillon; clots and then peptonizes casein; generates little or no gas in rabbits inoculated intravenously and then killed; and by subcutaneous inoculation in susceptible animals causes spreading bloody œdema with little or no development of gas-bubbles, and appears after death in filaments on serous surfaces.

The bacillus to which Lindenthal¹⁷ has quite unnecessarily given the name *Bacillus emphysematis vaginae* is doubtless identical with *Bacillus aërogenes capsulatus*. The same is

true of Veillon and Zuber's¹⁸ *Bacillus perfringens* found by them in appendicitis, by Guillemot¹⁹ in gaseous gangrene and by Soupault and Guillemot²⁰ in gaseous abscesses, and of Buday's²¹ *Bacillus cadaveris butyricus*, and Cesaris-Demel's^{21a} bacillus, both found in foamy organs. I am strongly inclined to the opinion that the anaërobic bacillus isolated by Achalmé and others from the blood and tissues of several cases of acute articular rheumatism and found by Savtchenko and Mielkitch in the soil is likewise identical with our gas-bacillus.²² As will be considered later, Gwyn has cultivated *Bacillus aërogenes capsulatus* also from the blood of a choreic patient during life.

Distribution.—The surmise expressed by Welch and Nuttall that the gas-bacillus is widely distributed in nature has since been confirmed. The natural habitat of the organism is the intestinal canal and the soil, the homes of so many other anaërobic bacteria. Welch and Flexner in 1896 brought evidence of the presence of the bacillus in both of the situations mentioned. Clopton of the Johns Hopkins Hospital has found the bacillus twice in the normal appendix vermiformis. Howard²³ has recently reported the presence of morphologically identical bacilli in the intestines of twenty-five consecutive human cases examined post mortem, and in ten of these he demonstrated the bacillus by cultures and inoculation of animals. The same conclusion concerning the regular presence of the bacillus in the intestine has been reached by Hitschmann and Lindenthal. The gas-bacillus has been repeatedly cultivated from the intestine in my laboratory, but we have made no systematic study of the frequency of its presence.^{23a} I have found the bacillus also in the intestines of rabbits, dogs and swine, and here it is interesting to note the frequency with which submucous gaseous blebs are found in the pig's intestine at autopsy.

In 1896 Dr. Walker, at the Johns Hopkins Hospital, succeeded in finding *Bacillus aërogenes capsulatus* in dust collected by sweeping floors, proving its presence both by cultures and animal experiments. My assistant, Dr. Harris, has cultivated the bacillus from the contents of an old cesspool. I had

previously reported in 1896 the isolation of the bacillus from a bullet removed from the head of the tibia in a case of gaseous phlegmon, and E. Fraenkel²⁴ has cultivated the gas-bacillus from a splinter of wood extracted from a wound in a case of tetanus. These observations confirm the natural inference to be drawn from the study of cases of traumatic emphysematous gangrene, in most of which the source of infection is manifestly foreign material, especially dirt, in wounds. In the light of these demonstrations of the wide distribution of the gas-bacillus in the outer world and in faeces, the conclusion is warranted that it must occasionally be present upon the human skin.

We are not informed whether there are differences in the regional distribution of the gas-bacillus. The fact that during the last decade a larger number of cases of emphysematous gangrene have been reported from Baltimore than from any other single locality is due probably to our interest in the subject and consequent search for cases. The bacillus has been found not only in America and Europe, but Dr. Flexner has brought reports of three infections with the gas-bacillus in Manila observed during a stay of three months.

GAS-BUBBLES IN THE BLOOD AND ORGANS.

We turn now to the consideration of the various conditions in which *Bacillus aërogenes capsulatus* has been found in human beings. We need not pause to consider the occasional presence of this bacillus in ordinary cadaveric decomposition, a circumstance sufficiently explicable by the occurrence of the organism in the healthy intestinal canal.

Of an entirely different nature are the cases in which gas bubbles are found in the blood and organs within a few hours after death and without any trace of ordinary putrefaction. Such a condition has been recognized at autopsies as soon as one, two, three, five, eight hours after death. It may occur not only after death from gaseous phlegmon, when, however, it is by no means constant, but also after death from the most varied causes. It has been observed repeatedly in autopsies on pregnant and puerperal women, especially after death from abortion and acute sepsis. Cases reported by Cless²⁵, Jürgensen,²⁶ Vachetta,²⁷ Dunin,²⁸ Vogel²⁹ and others as examples of entrance of air or gas into the circulation from gastric ulcers, typhoid or dysenteric ulcers, pulmonary tuberculosis, septicæmia and various other diseases, find now their natural explanation in the invasion of gas-bacilli, instead of in the curious hypotheses propounded by the authors cited. In the probability, although I have had no opportunity to observe such a case, the free gas which has been repeatedly found

¹⁸ Arch. de méd. exp., 1898, X, p. 539.

¹⁹ Compt. rend. Soc. de biol., 1898, 10. s., V, p. 1017.

²⁰ Bull. et mém. Soc. med. d. hôp. de Paris, 1900, 3. S., XVII, p. 216.

²¹ Centralbl. f. Bakt., 1898, XXIV, p. 369.

^{21a} Giornale d. R. Accad. di med. di Torino, 1898, LXI, p. 256 and LXII, p. 190.

²² Achalmé, Ann. de l'Inst. Pasteur, 1897, XI, p. 845; Pic and Lesieur, Journ. de phys. et de path. gén., 1899, I, p. 1007, and Savtchenko and Mielkitch, Arch. russes de path., 1899, VIII, p. 145.

²³ Contributions to the Science of Medicine dedicated by his pupils to William Henry Welch on the 25th Anniversary of his Doctorate, p. 461, Baltimore, 1900.

^{23a} Mr. Hirshberg is now engaged in my laboratory in a study of the distribution of the gas-bacillus in human and animal intestines and in the outer world and will report his observations later.

²⁴ Münch. med. Woch., 1899, Nos. 42 and 43.

²⁵ Luft im Blute, Stuttgart, 1854.

²⁶ Deutsches Arch. f. klin. Med., 1882, XXXI, p. 441, and 1883, XLI, p. 569.

²⁷ Sull' embolismo gassoso per penetrazione d'aria nel sistema circolatorio, Pisa, 1880.

²⁸ Berliner klin. Woch., 1882, p. 11.

²⁹ Ibid., 1882, p. 187.

the blood-vessels and heart after deaths from chloroform is due likewise to the invasion of the gas-bacillus, and is not, as supposed by Haukel,³⁰ nitrogen derived from air pressed through the lungs into the pulmonary blood-vessels in violent expiratory movements with closed glottis.

There is every gradation from cases with a few bubbles of gas in the blood or tissues to those with extensive emphysema of the organs and tissues. The term "foamy organs" (Schaumorgane of the Germans) may be applied to the latter condition. The liver is the organ most frequently the seat of early and abundant development of gas, but there is no definite rule as to the distribution and amount of gas in different cases. The gas may be limited to the abdominal veins or to the pulmonary vessels or to one of the cardiac cavities, or be found only in the tissues at one place, especially near the stomach or intestine. It is more abundant in the veins than the arteries, and may be only in the former. As will be explained later the invasion in the majority of cases is from the intestine. That the gas-bubbles may be dislocated from their original position in liquid and soft material in the body is self-evident, but I have not found them unassociated with gas-bacilli.

Formerly this early presence of free gas in the heart and vessels, without evident post-mortem decomposition, was very generally explained by the assumption of entrance of air into the circulation, even when no portal of entry could be found.³¹ The most extensive application of this explanation was made in the pregnant and puerperal cases. It is remarkable that the first case of this nature to be examined bacteriologically was that reported by me in 1891. In this and in nearly all subsequent similar cases with satisfactory bacteriological examination *Bacillus aerogenes capsulatus* was found.

The main questions which arise concerning the interpretation of these cases are whether the invasion of the bacilli and whether the development of the gas are ante-mortem or post-mortem phenomena.

Rabbits survive the introduction of large numbers of gas-bacilli directly into the circulation, unless there exists somewhere in the body necrotic or damaged tissue offering little or no vital resistance. If the animal be killed within a few minutes after the intravenous injection of the bacilli and kept in a warm place, there are abundant multiplication of the bacilli and large development of gas throughout the body within the space of six or eight hours; whereas if the bacilli be introduced at one point, as for example the right heart, of a rabbit just killed, it takes a much longer time. In twenty-four to forty-eight hours, for gas and bacilli to make their appearance at points far distant from the seat of inoculation. It seems justifiable to draw from these three groups of experiments, which have been fully reported by Leh and Nuttall, the conclusion that when bacilli and gas are found within a few hours after death widely distributed

in the body, the gas-bacilli have entered the circulation during life, but probably in most cases only shortly before death.

There is one factor, however, to be considered which is absent in the experimental cases and may be present in human beings, to wit, the quick disappearance of the bactericidal power of the blood. This factor is an important determinant of the rapidity of onset of post-mortem decomposition. Very soon after death from certain diseases, and particularly from snake-venom, bacteria may make their appearance in the blood and organs. An explanation of these cases is furnished by the experiments of Ewing and myself,³² which demonstrated that the blood of rabbits killed by rattlesnake venom is practically devoid of bactericidal power, so that immediately after or even shortly before death bacteria can start growing in the body as they would in a tube of beef-broth. But after all due allowance has been made for the possible reduction or loss of bactericidal power of the blood, I still consider that it is not possible to explain some of the cases in which bacilli and gas have been found in the heart, blood-vessels and organs very soon after death, especially when the corpse has been kept in a cold place, otherwise than upon the assumption of the distribution of the bacilli by the circulating blood.

It is another question whether gas as well as bacilli may be present in the circulating blood and internal organs during life in the class of cases now under consideration, and I regret to be unable to furnish a positive answer to this question. I do not see how an affirmative answer can be obtained otherwise than by the actual demonstration of gas in these situations either during life or immediately after death. Gas-bubbles and bacilli have been found in the heart and vessels within an hour after death, but that is time enough for bacilli which have already been introduced to multiply and begin to form gas. I at first thought that absence of nuclear staining around the gas-bubbles and masses of bacilli might serve as an indication of their presence during life, and this view is advocated by P. Ernst, but I have since learned from experiments on rabbits that this is not a decisive criterion, although often both in rabbits and in human beings there is no defect in nuclear staining around bacilli and gas-bubbles.

I know of no other pathogenic microorganism which offers such difficulties in determining whether its effects in the interior of the body have been produced before or after death. The difficulty arises from the circumstances that these effects in most cases and most situations consist almost entirely in local necrosis and formation of gas, whether the invasion and growth of the bacilli be before or after death, and that unlike most pathogenic bacteria the gas-bacillus grows better in the dead than the living body. Possibly some importance in the solution of the problem may attach to the demonstration of emboli of liver cells and of bone-marrow cells which were in enormous numbers in the pulmonary vessels in a case of gaseous phlegmon of the sub-mammary tissues following infusion of salt-solution. At the autopsy made by Dr. Carroll

Cless. Luft im Blute. Stuttgart, 1854, and Couty. Thèse, Paris, 1875.

³² Lancet, 1894, I, p. 1236.

the liver and other organs were emphysematous. Further observations with reference to these emboli in this class of cases are needed.

I do not consider that there is any inherent improbability in the supposition that gas-bubbles may be in the circulating blood during life without causing speedy death from gaseous embolism. It is only when a large volume of air is introduced quickly into the blood-current that sudden death results from air-embolism. Very exaggerated ideas have prevailed among physicians as to the dangers from the entrance into the circulation of small quantities of air. Laborde and Muron³³ injected into the external jugular vein of a dog 1120 cc. of air in the space of one hour and a half without causing death, and Jürgensen,³⁴ into the left femoral artery of a narcotized dog weighing 43½ kilo, 3650 cc. in the space of two hours and twenty-five minutes with only slight disturbance of the respiration and of the action of the heart. Hare,³⁵ on the basis of experiments, likewise controverts current beliefs concerning the dangers from entrance of a moderate quantity of air into the veins.

I have come across in the older literature from the days when venesection was a common practice, reports of cases in which blood containing bubbles of gas escaped during venesection from veins of the arm.³⁶ In none of these was there evidence that air had gained entrance to the circulation. Maisonneuve,³⁷ in incising two gaseous phlegmons of the thigh following compound fracture, observed the escape of blood containing gas-bubbles from the cut veins and was able to trace the gas within the veins for a long distance.

It seems to me very improbable that an anaërobic bacillus, such as the gas-bacillus, can multiply in the circulating blood, still this bacillus is less sensitive to the presence of oxygen than many anaërobes, and we do not know whether the loose combination in which oxygen is present in the blood would necessarily prevent its growth under all circumstances.

I see no reason why this bacillus might not multiply and form gas in the liver, spleen and most other internal organs, as we know it can do in parts open to inspection during life. We have positive evidence in the cases reported by Graham, Stewart and Baldwin and by Dunham that gas-bacilli may be conveyed by the circulation from an infected portal of entry—in the one case the puerperal uterus and in the other a urethral wound—to distant parts of the body and there produce subcutaneous emphysema and necrosis. There is no part of the body which offers such favorable conditions for the post-mortem growth of the bacillus as the liver, probably on account of its content of carbohydrate, and, if the liver like

the integuments were open to inspection during life, I believe that we should find evidence that in certain cases the emphysema of this organ, which is such a conspicuous post-mortem phenomenon in instances of invasion by the gas-bacillus, had begun during the life of the patient. As will be considered subsequently emphysema of mucous membranes open to inspection, we know can exist during life.

In the great majority of the instances, however, in which gas-bubbles are found in the blood and internal organs at autopsy the evidence is in support of the view that the development of the gas is a purely post-mortem phenomenon. Certainly the greatest caution should be exercised in the interpretation of any such cases as vital processes, even in early autopsies without ordinary putrefaction. One thing which our investigations have established is that the finding of gas-bubbles in the blood-vessels and heart within so short a time as one hour after death furnishes in itself no proof of the entrance of air into the circulation. Especially is it to be emphasized that the limitation of gas to the right heart and adjacent vessels may occur in cases of invasion by the gas bacillus and is not, as is often represented, peculiar to air embolism. I shall refer later to the question of gaseous embolism in cases of emphysematous gangrene and of physometra.

EMPHYSEMATOUS GANGRENE.

In a few instances we have found in wounds, usually compound fractures or gunshot injuries, in which dirt had gotten in, *Bacillus aërogenes capsulatus* without the presence of gas or other evidence that the bacillus was producing any characteristic effects.³⁸ Such cases have always been watched by the surgeons with anxiety, and it is probable that at least in some the early recognition of the bacillus followed by free incisions and thorough cleansing and disinfection has warded off a subsequent grave infection. In view of the wide distribution of the gas-bacillus in the outer world and in the intestinal contents it is probable that it must not so very infrequently gain access to wounds without securing a foothold. While this innocent behavior, with which we are also familiar in the case of the tetanus bacillus, may sometimes be due to attenuated virulence of the bacillus, it is probably oftener attributable to accessory circumstances, such as the resistance of the patient, the condition of the wound and surrounding tissues, and lack of association with suitable microorganism and foreign substances.

It is as a cause of that most dreaded of wound complications, emphysematous gangrene, that *Bacillus aërogenes capsulatus* especially claims the interest of surgeons. The classical clinical descriptions of this disease we owe to Maisonneuve³⁹ and to Pirogoff,⁴⁰ the former giving to it the name

³³ Comptes rend. Soc. de la biol., 1873, V.

³⁴ Deutsches Arch. f. kl. Med., 1882, XXXI, p. 458.

³⁵ Therap. Gazette, 1889, 3. S., V, p. 606.

³⁶ Marshall's case reported by May, Trans. Path. Soc., London, 1858, IX, p. 157; Durand-Fardel's case also cited by May, and Pirogoff's case in his Grundzüge d. allgem. Kriegschirurgie, p. 1063, Leipzig, 1864.

³⁷ Cited from Hitschmann and Lindenthal, Sitzungsber. d. k. Akad. d. Wiss., Math.-Naturw. Cl., Wien, 1899, CVIII, iii, 3, p. 67.

³⁸ Such cases have been reported by Bloodgood from the Johns Hopkins Hospital in Progressive Medicine, 1899, IV, December, p. 158.

³⁹ Gaz. méd. de Paris, 1853, p. 592.

⁴⁰ Grundzüge d. allgem. Kriegschirurgie, pp. 867 and 1006, Leipzig, 1864.

"gangrène foudroyante," and the latter designating it "primary mephitic gangrene" or "acute gangrenous œdema." Among other more or less common designations are "emphysematous or gaseous gangrene," "gaseous phlegmon," "septic emphysema," "érysipèle bronzé" (Velpéau), "progressive gangrenous œdema," "gangrenous septicæmia," and "emphysematous cellulitis."

This wound complication was more common in preantiseptic times, especially in military surgery, than it is to-day, but at least 70 cases have been reported during the last quarter of a century. In prebacterial days the affection was attributed by some writers to the penetration of air into the tissues, but by most to the decomposition of the tissues, particularly of adipose tissue and bone-marrow, brought by an injury into contact with the atmosphere.

Bottini⁴¹ in 1871 was the first to demonstrate the infective nature and transmissibility of emphysematous gangrene.

Later Gussenbauer⁴² also recognized the disease as a definite infection and attributed it to the bacteria of putrefaction. After Pasteur's discovery in 1877 of his "vibron septique," more commonly, since Koch and Gaffky's investigations, designated *Bacillus œdematis maligni*, and especially after Chauveau and Arloing's⁴³ paper in 1884, cases of emphysematous gangrene have been usually reported, especially in France, as instances of Pasteur's gangrenous septicæmia or Koch's malignant œdema. W. Koch's⁴⁴ attempt to identify the disease with symptomatic anthrax (Rauschbrand) was based on faulty bacteriological studies and has met with no confirmation. In 1884 F. J. Rosenbach⁴⁵ reported finding in coverslip specimens from two cases of traumatic emphysematous gangrene coarse bacilli, some of which had terminal pores. These he was unable to cultivate, only aerobic methods being employed. It is probable that Rosenbach saw *Bacillus aerogenes capsulatus* in these cases, but without distinguishing it from associated spore-bearing bacilli.

A critical examination of the records of alleged malignant œdema in human beings shows that in very few was the organism concerned satisfactorily identified as the genuine malignant œdema bacillus. Very often it has been simply assumed without more than a microscopical examination that bacilli found in spreading œdematous conditions with or without gas have been those of malignant œdema, and even where cultures and animal experiments have been employed the descriptions are frequently so meagre as to leave the identity of the organism wholly in doubt. In France it is usually assumed without any discussion and even without any bacteriological examination that gangrène foudroyante is malignant œdema (Pasteur's septicæmia),⁴⁶ and the same ignorance

of the present status of this subject is still sometimes encountered in England, Germany and elsewhere. Nevertheless the investigations of the last seven years, beginning with those of E. Fraenkel and soon followed by observations of myself and collaborators, have demonstrated that by far the most common and important specific cause of gaseous phlegmons or emphysematous gangrene is *Bacillus aerogenes capsulatus*.

Whether the bacillus of malignant œdema can produce an identical or similar anatomical and clinical affection in human beings I regard as an unsettled question. It is certainly remarkable in view of current doctrines in text-books that neither E. Fraenkel nor I, with our relatively large experience, nor indeed, so far as I am aware, any one who has made himself thoroughly acquainted with *Bacillus aerogenes capsulatus*, has encountered an instance of emphysematous gangrene in man caused by the bacillus malignant œdema. The whole subject of human malignant œdema is one which needs thorough revision and investigation by more exact bacteriological methods than have yet been applied to it.⁴⁷ I have already mentioned the chief points of difference between the bacillus of malignant œdema and *Bacillus aerogenes capsulatus*.

There is a relatively small group of cases of gaseous phlegmon attributed by those reporting them⁴⁸ either to the colon bacillus or the proteus bacillus. In most of these cases anaerobic culture methods were not employed. No one has succeeded in producing experimentally gaseous phlegmon with either of these bacilli, and I think there is good reason to be skeptical concerning their capacity to produce this disease, unless perhaps *Bacillus coli* may do so in diabetics.

It is possible that some of those reporting the colon bacillus as the cause of emphysematous gangrene may have confounded with it a facultative anaerobic bacillus which we have isolated from two cases of this disease, and which has been studied in my laboratory by Dr. Lanier. It resembles in anaerobic cultures very closely *Bacillus aerogenes capsulatus*, but it is capable of aerobic growth also, and then the rods are thinner and more like colon bacilli. It has the power of producing gas abundantly in the blood and tissues of rabbits killed a few minutes after intravenous injection, a power not possessed by genuine colon bacilli. I have already spoken of

10. S., V, p. 1017) who has found *B. aërog. caps.* (*B. perfringens*) in a case of gaseous gangrene and who controverts the prevalent view of French authors who attribute this disease exclusively to Pasteur's vibrio.

⁴⁷ In the case reported recently by Brabec (Wiener klin. Rundschau, 1900, XIV, pp. 145 and 167) the identification of the malignant œdema bacillus seems satisfactory. Here there was extensive bloody œdema without gas, so that the case was not one of emphysematous gangrene. On the other hand, Hämig and Silberschmidt (Correspondenzbl. f. Schweizer Aerzte, 1900, XXX, p. 361) bring no proof of any consequence that they were dealing, as they supposed, with the malignant œdema bacillus in two cases of gangrène foudroyante.

⁴⁸ Chiari, v. Dungern, Bunge, Klemm, Hlava, Evans, Grasberger, Hauser, Margarucci, Muscatello, Hitschmann and Lindenthal.

⁴¹ Gior. d. r. Accad. di med. di Torino, 1871, 3. S., X, pp. 1121 and 1138.

⁴² Deutsche Chirurgie, Lief. 4, Stuttgart, 1882.

⁴³ Bull. Acad. de Méd., 1884, 2. S., XIII, p. 604.

⁴⁴ Deutsche Chirurgie, Lief. 9, Stuttgart, 1886.

⁴⁵ Die Mikroorganismen bei den Wund-Infektions-Krankheiten

des Menschen, Wiesbaden, 1884.

⁴⁶ An exception is Guillemot (Compt. rend. Soc. de biol., 1898,

the importance of this test, which has been employed by none of the writers who have claimed to find colon bacilli as the cause of gaseous phlegmons. This bacillus, when virulent, is capable of causing the same spreading and fatal emphysematous necrosis in guinea-pigs and pigeons as is *Bacillus aërogenes capsulatus*.

I have been accustomed to speak of this bacillus, to which I have called attention in previous publications, as the aërobic variety of our gas-bacillus. I believe, however, that it is identical with Sanfelice's *Bacillus pseudo-œdematis maligni*,⁴⁹ with which he is inclined to identify Klein's "new bacillus of malignant œdema."⁵⁰ Chavigny⁵¹ has isolated apparently the same bacillus, which he likewise identifies with Sanfelice's *Bacillus pseudo-œdematis maligni* (not to be confounded with the pseudo-œdema bacillus of Liborius), from a case of gaseous gangrene, and he also calls attention to the probability that others may have mistaken it for the colon bacillus. While, therefore, unwilling upon existing evidence to accept the colon bacillus as a demonstrated cause of gaseous gangrene (except perhaps in diabetics), I am of the opinion that an aërobic bacillus, probably identical with Sanfelice's *Bacillus pseudo-œdematis maligni*, is capable of producing this affection, but it is much less frequently concerned than *Bacillus aërogenes capsulatus*.

I have collected 46 cases of emphysematous gangrene, in all of which *Bacillus aërogenes capsulatus* was demonstrated, and, therefore, all reported or observed during the last seven years.⁵² This is a far larger number of cases than has ever been brought together before.

⁴⁹ Ann. d. Istit. d'Igiene sper. d. Univ. di Roma, 1891, N. S., I, p. 365, and Ztschr. f. Hyg., 1893, XIV, p. 352.

⁵⁰ Centralbl. f. Bakter., 1891, X, p. 186.

⁵¹ Ann. de l'Inst. Pasteur, 1897, XI, p. 860. Perhaps the bacillus found by Foà and Bonome (Ztschr. f. Hyg., 1889, V, p. 403) in a case of anthrax-like septicemia with gas in the tissues was Sanfelice's bacillus. Roncali in the Italian translation of Senn's Surgical Bacteriology (*Bacteriologia Chirurgica*, p. 109) also claims Sanfelice's bacillus as a cause of gaseous gangrene.

⁵² This list includes 16 cases observed in Baltimore, mostly at the Johns Hopkins Hospital, of which 2 are unpublished, and the remaining 14 have been published by Mann (1), Ann. Surg., 1894, XIX, p. 187; Welch and Flexner (6), Journ. Exp. Med., 1896, I, p. 5; Martin (1), University Bulletin, 1896, I, No. 3, and Bloodgood (6), Progressive Medicine, 1899, IV, December, p. 158. The notes of an additional unpublished case observed in Manila have been given me by Dr. Flexner. There are also 3 unpublished cases for the records of which I am indebted to Dr. Carroll of Washington.

The references to the remaining 26 cases are as follows: E. Fraenkel (4), Ueber Gasphlegmonen, Hamburg u. Leipzig, 1893; Passow (1), Charité-Annalen, 1895, XX, p. 275; Dunham (5), Bulletin of the Johns Hopkins Hospital, 1897, VIII, p. 68; Ferguson (1), Trans. Indiana Med. Soc., 1897, p. 339; Erdmann (1), Med. Record, Feb. 5, 1898, p. 205; Le Boutillier (1), Med. Record, March 5, 1898, p. 353; Love and Cary (1), Med. Record, April 8, 1899; Norris (1), Amer. Journ. Med. Sc., 1899, CXVII, p. 195; Hitschmann and Lindenthal (5), Sitzungsber. d. k. Akad. d. Wiss., Math.-Naturw. Cl., Wien, 1899, CVIII, Hft. iii, Abth. iii, p. 67; Thorndike (2), Boston Med. and Surg. Journ., June 7, 1900, p. 592; Muscatello with Gangitano (3), Riforma med., 1900, II, pp. 508,

Thirty-two are reported by American observers and only 14 by foreign investigators. Of the former group of cases 14 were observed in Baltimore, most of the cultures having been studied in my laboratory; of the foreign group of cases all are reported from Germany, Austria, Italy and France, 4 by E. Fraenkel, 1 (not absolutely certain) by Passow, 5 by Hitschmann and Lindenthal, 3 by Muscatello assisted by Gangitano and 1 by Guillemot.⁵³

Cases of gaseous phlegmon in which *Bacillus aërogenes capsulatus* was not demonstrated are not included, although many of these presented the same clinical characters and doubtless in some at least the gas-bacillus was the active agent. This is true especially of the cases of gangrène fœdoyante, usually without satisfactory bacteriological examination, attributed by French writers to Pasteur's vibrio septique. Gertler's⁵⁴ eight cases of gaseous phlegmon cannot be utilized for our purposes at all, as they are without any satisfactory bacteriological reports.

A complete analysis of these 46 cases would afford material more than sufficient to occupy this entire address, so that I shall be able to present here only some of the more important points.

Thirty-five of the patients were males, 10 females and of one the sex is not stated. The preponderance of males is to be explained by the fact that most of the cases were due to severe injuries. Robust workmen in the prime of life furnished the largest contingent of cases.

In 80 per cent of the cases one of the extremities was the seat of the emphysematous gangrene, the lower being affected a little over twice as often as the upper extremities. In several instances the emphysema extended from the thigh to the abdominal wall or from the arm to the subcutaneous tissue of the shoulder and chest. There were three examples of primary emphysematous phlegmon of the abdominal wall: of these one following removal of the appendix (Bloodgood), one from an unrecognized strangulated Littre's hernia (Martin), and one affecting the deep tissues of a nephrectomy wound (Muscatello). In all of these the infection is believed to have started from the intestine. In one of Dunham's cases there was emphysematous gangrene (originating in a prostatic abscess opening in the buttock) of the scrotum, penis, and anterior abdominal and thoracic subcutaneous tissues. In three instances (Carroll (2); Dobbin (1) reported by Bloodgood) the breast and submammary tissues were the primary

519 and 530; Guillemot (1), Compt. rend. Soc. de biol., 1898, 10. S. V, p. 1017. A few other cases in which the gas-bacillus was found are not reported with sufficient detail to be available for analysis. It is safe to say that *B. aërog. caps.* has now been found in over 50 cases of gaseous gangrene.

⁵³ Soupault and Guillemot (Bull. et mém. Soc. méd. d. hôp. d. Paris, 1900, 3. S., XVII, p. 216) have reported two gaseous abscesses following hypodermic injections, and a third which they regard as metastatic, in which they found the gas-bacillus (*E. perfringens*), once in pure culture. These cases will be considered subsequently under the heading "Gaseous Abscesses."

⁵⁴ Ueber Gasphlegmonen. Inaug.-Diss. Halle, 1898.

at of the disease, all of these resulting from the infusion of salt solution. In one case (Dunham) the gaseous phlegmon appeared at the angle of the lower jaw after incision of a foul submaxillary abscess. In one instance (Welch and Flexner) it started within the pelvis from traumatic rupture of the rectum and extended through the sciatic notch down the thigh. Of especial interest are three examples of multiple or metastatic emphysematous gangrene, one of the forearm and opposite shoulder, another of the thigh and both shoulders, and still another of one shoulder and the buttocks. In the older literature are similar cases; thus Nélaton observed emphysema not only in the injured leg but also in the opposite, uninjured extremity. In 1897 Leech⁵⁵ reported without adequate bacteriological examination a case of emphysematous gangrene of the right leg following about three weeks after injury of the right thumb, which became inflamed, there being no evident local cause of the affection of the leg. These cases are to be explained by transportation of the bacilli through the lymphatic or blood-current from the primary focus of entrance.

In all but 5 of the 46 cases the emphysematous gangrene followed traumatism or a surgical operation. The injuries were as follows: compound fractures, 18; bullet and gunshot wounds, 7; infusion of salt solution, 3; hypodermic injections, 2; ligation of the femoral artery for aneurysm, 3; internal urethrotomy, 2; traumatic rupture of the rectum, removal of the appendix, prostatic abscess following self-catheterization, operation for strangulated, Littré hernia, incision of a foul submaxillary abscess, and nephrectomy, each 1. In the 5 non-traumatic cases the gaseous gangrene followed erysipelas in one, was consecutive to apparently spontaneous gangrene in 2, whether diabetic or not is not stated, and was without apparent explanation in two (Fraenkel's Case 2 and 3).

Compound fractures and next bullet and gunshot wounds occupy by far the most prominent place in this list, each of the other various causes being represented only by scattered cases. Those injuries in which there are much laceration and washing of tissue, comminution of bone and grinding of dirt, or of clothing or other foreign bodies into the wound are the ones most likely to be followed by emphysematous gangrene. That, however, severe traumatism is not an essential factor is shown by the 5 cases (10.9 per cent of the entire number) following hypodermic injections and infusion of normal salt solution (see cases also under "Gaseous Abscesses.") These latter, however, were all of patients whose vital forces were greatly depressed, namely, by Asiatic cholera, typhoid fever, surgical shock, or post-partum hæmorrhage. There is good reason to believe that the intact tissues of human beings in health possess marked resistance to the gas-bacillus.

In the great majority of cases it was evident that the gas-bacillus was introduced through the wounded skin from without. In three instances (removal of appendix, strangulated

hernia, and traumatic rupture of the rectum) the infection undoubtedly came from the intestine. This was also the probable source of infection in one of Muscatello's cases (gaseous phlegmon in the site of an extirpated kidney). With our present knowledge of the frequent, if not regular, presence of *Bacillus aerogenes capsulatus* in the intestine, there is nothing surprising in this mode of infection. In three of Dunham's cases the infection followed injury of the urethra, and here also the bacilli may have come primarily from the intestine. In one of his cases (gaseous phlegmon at angle of the jaw) it was suggested that the bacilli gained entrance through decayed teeth.

Bloodgood thinks it probable that in one of his cases the gas-bacilli were brought by the circulation to the seat of infection. In this case the femoral artery was ligated for traumatic arterio-venous aneurysm in the popliteal space. There was no primary infection of the wound, but gangrene of the foot and leg ensued and on incision gas-bubbles were found in the blood of the aneurysmal sac and the tissues. With what we know about the entrance of intestinal bacteria into the circulation, there is nothing improbable in Bloodgood's opinion, which is also supported by Lanier's and Muscatello's experiments already mentioned. The clot in an aneurysm and tissues robbed of their nutrient supply would offer little or no resistance to the growth of bacilli which might reach them or their immediate neighborhood through the circulation and the conditions would be anaërobic. It was indeed a case of aneurysm in which I first found the gas-bacillus, and here the clot was swarming with bacilli. It is interesting to note that three of the cases of emphysematous gangrene in my list followed ligation of the femoral or popliteal artery for aneurysm.

Pirogoff⁵⁶ distinguished clinically two groups of cases of traumatic emphysematous gangrene. He described under the name "primary mephitic gangrene" cases in which the emphysema appears within two days after the injury, the "local stupor" passing without inflammatory reaction into erepitating gangrene. Here the emphysematous necrosis spreads rapidly, the patient sinks into collapse with an icteroid hue of the skin, small, thready pulse and cold sweats, and death occurs usually within a few days after the onset. This type of the disease corresponds to Maisonneuve's *gangrène foudroyante*. In the second group, designated by Pirogoff also as "acute gangrenous œdema," there is reaction from the primary "local stupor" of the tissues, the emphysema is preceded and accompanied by local, œdematous or purulent inflammation, is associated with febrile reaction, often appears later after the injury and spreads less rapidly, and presents in general a more varied anatomical and clinical picture than the first class of cases.

Hitschmann and Lindenthal consider that Pirogoff's first group corresponds especially to cases of pure or predominant infection with the gas-bacillus, and his second group to mixed infections. Erdmann is also of the opinion that in the un-

Quart. Med. Journ. (Sheffield), 1896-97, V, p. 237.

⁵⁶ Grundzüge d. allg. Kriegschirurgie, p. 1006, Leipzig, 1864.

mixed infections the emphysematous necrosis spreads more rapidly and is more likely to terminate fatally. On the other hand, Muscatello and Gangitano, who also divide the cases into two groups—pure infections and mixed infections—hold that the mixed infections are characterized by the rapidly progressive form of emphysematous gangrene, while the pure infections, at least in their early stage, show little tendency to spread beyond the injured tissues. According to the last named authors the gas-bacillus is incapable of exerting any pathogenic action upon healthy tissues, but attacks only tissues already altered in their vitality by injury, other pathogenic microorganisms, toxins, or other depressing factors.

The study of our cases has not enabled me to adopt in their exclusive form either of the two conflicting opinions just stated. Of the collected 46 cases, 30 were mixed infections, 14 were pure and of 2 there is no clear statement on this point. The most common associated bacteria were the pyogenic streptococci and staphylococci. Among other forms found occasionally were *Bacillus coli*, proteus, pyocyaneus, tetanus, Sanfelice's *Bacillus pseudo-œdematis maligni*, and uncultivable, often spore-bearing, bacilli. It seems probable that the bacillus of malignant œdema, being a common inhabitant of the soil, must occasionally, like the tetanus bacillus, be present, but it was not isolated from any of these cases. My experience is that if reliance be not placed exclusively upon cultures, but careful microscopical examinations be also made, instances of unmixed infection with *Bacillus aerogenes capsulatus* are rare. It is by no means always easy to determine whether associated bacteria are exerting pathogenic action or not. Pyogenic cocci may be present without producing pus or marked inflammatory reaction.

We have found rapidly progressive forms of emphysematous gangrene both with pure infection with the gas-bacillus and with mixed infections, and on the other hand we have observed with both types of infection cases in which the tendency to spread is much less marked. In all of the cases with much purulent inflammation mixed infection was present, but aside from this feature the division of the cases into pure and mixed infections does not, according to our experience, correspond to different, sharply marked, clinical features. Pirogoff's classification is doubtless of clinical value, but there is every gradation between the two groups.

I cannot agree with Muscatello and Gangitano, whose investigations of emphysematous gangrene are of great value, that the gas-bacillus is incapable of attacking healthy tissues. Virulent cultures, even in moderate doses, can produce rapidly spreading gaseous phlegmons when inoculated into the subcutaneous tissues of susceptible animals such as guinea-pigs and pigeons. In human beings the emphysema may extend very rapidly into the healthy tissues, frequently outstripping in its advance the inflammatory œdema. This may occur in pure, as well as in mixed, infections with the gas-bacillus. After amputation through apparently healthy tissues there may be rapidly spreading emphysema from the stump (Welch and Flexner's Case II). The two instances of men-

ingitis observed by Hitschmann and Lindenthal and by Howard speak also for the power of the gas-bacillus to attack healthy tissues. It is true, as urged by Muscatello and Gangitano, that toxins derived from the bacilli may prepare the tissues for the invasion and action of the advancing bacillus, but the same explanation has been put forward for the spread of other pathogenic bacteria in healthy tissues. In asserting that the gas-bacillus may attack healthy tissues, I would not be understood as minimizing the great importance of the various accessory causes of emphysematous gangrene which act by lowering the vitality of the tissues or the general resistance of the patient, or as failing to recognize the marked resistance to infection by the gas-bacillus offered by the healthy tissue, a resistance to which I have previously called attention and which I shall have occasion further to emphasize.

Gas may appear in the tissues as early as eight hours after the injury. In a case of gaseous phlegmon following a bullet wound of the knee joint, reported by Welch and Flexner, Dr. Bloodgood recognized gas in the joint⁵⁷ and surrounding tissues just twenty hours after the injury. In a case of Dr. Tiffany's, which we have reported, death from emphysematous gangrene, due to pure infection with the gas-bacillus, occurred forty-eight hours after a fall causing a compound, comminuted fracture of the patella with grinding of the underlying bone and clothing into the wound. There was no other injury of the body. Any one who has seen one of these rapidly fatal cases of spreading, traumatic, emphysematous gangrene will receive an impression which he will never forget.

The anatomical and clinical study of uncomplicated emphysematous gangrene demonstrates that the disease is not, as many formerly supposed, simply an intense variety of ordinary phlegmonous inflammation or cellulitis, but is a disease sui generis. It may be combined with phlegmonous inflammation, but then some other microorganism, usually the streptococcus, is associated with the gas-bacillus.

In typical uncomplicated cases the lesions consist in necrosis of all the tissues, the presence of gas in the interstices, infiltration with blood, evidences of the mechanical action of the gas, and exudation of a variable amount of bloody serum. The amount of gas varies much in different cases. There may be only a few bubbles or the tissues may be everywhere bloated up with gas. The nuclei disappear by karyolysis. The notable thing in most cases is a nearly complete absence of leukocytes and of cellular reaction, although in a few instances, even of pure infection, I have found leukocytes in considerable number, and even purulent foci, but generally at a distance from the primary necrosis. As will be shown later *Bacillus aerogenes capsulatus* in certain situations is capable of setting up purulent inflammation. In one of our cases, reported by Bloodgood, Dr. Cushing found gas-bacilli without gas in a small subcutaneous abscess of a stump ty-

⁵⁷ It is to be regretted that in the cases reported by Pirogoff (Deutsche Zeitschr. f. Chirurg., 1898, XLVII, p. 591), as traumatic entrance of air into the knee joint, no bacteriological examination was made.

months after amputation of the thigh for emphysematous gangrene of the leg, the amputation having been followed by uninterrupted convalescence.

After death there may be rapid extension of the subcutaneous emphysema, and at autopsies made a few hours after death gas-bubbles may be found in the heart, vessels, liver and other organs, but as to this occurrence there is no rule. As I have already explained wide-spread distribution of gas in the blood and organs in early autopsies indicates entrance of the bacilli into the circulation during life.

As is to be expected from the etiology of many of the cases of emphysematous gangrene, emboli of fat and of bone-marrow are common in the pulmonary capillaries, but I do not know that in any case they contributed to the fatal result.

The prognosis of emphysematous gangrene is more favorable to-day than before the antiseptic period. The disease terminated fatally in 59 per cent of the cases in my list. In the cases observed and treated at the Johns Hopkins Hospital 10 in number—the fatality was 50 per cent, but of these there was a gaseous phlegmon of the pelvis extending to the thigh, resulting from traumatic rupture of the rectum, a second was a gaseous phlegmon of the abdominal wall following removal of the appendix and complicated with diffuse gangrenous peritonitis, and a third case terminated twenty-five days after disappearance of a gaseous phlegmon of the thigh (treated by incisions) from a late streptococcus infection, gas and the gas-bacillus having disappeared. Of the remaining fatal cases in one—emphysematous gangrene following compound fracture of the thigh—amputation was refused by the patient until the fourth day when he was in a state of collapse and died fifteen hours later, and in the other compound fracture of the skull and both lower extremities the patient died thirty hours after the accident, having never regained consciousness.

When the disease is accessible to surgical treatment, is not complicated by other grave conditions, and is promptly recognized and treated, the prognosis, according to the experience of my surgical colleagues, Professor Halsted and Dr. Bloodgood, is not very unfavorable.

The clinical evidence favors the view that, at least in most complicated fatal cases, death is due to toxæmia. Norris is unable to demonstrate the presence of strong toxins in official cultures of *Bacillus aerogenes capsulatus*, but, as is well known, the same difficulty is encountered with many other pathogenic bacteria which are believed to produce sepsis in the human body. Muscatello is also of the opinion that the constitutional symptoms are attributable to toxæmia. The suggestion that death may be due to gaseous embolism is not new. Pirogoff and other of the older observers knew that gas-bubbles may be found within the heart and vessels very soon after the death of patients from emphysematous gangrene. In the discussion on Langenbeck's paper on traumatic infiltration before the Society of German Military Surgeons in 1870, Senator⁵⁵ advocated the supposition that death

is caused by gas-embolism. While the possibility of this occurrence as the cause of death may be admitted, there is at present no proof of this opinion. Gas-bubbles are by no means always found in the blood and organs after death from emphysematous gangrene, and the clinical histories of those in whom they are found post mortem do not appear to differ from those where they are absent. In experimental gaseous phlegmons in guinea-pigs there is no evidence of the presence of gas-bubbles in the circulation during life.

In one of our cases (Mann) death resulted from tetanus and Verneuil⁵⁶ has reported three cases which without bacteriological examination he, in conformity with current French opinion, calls malignant oedema, where also tetanus intervened. There is nothing surprising in this association when one considers that the home of the tetanus bacillus, like that of the gas-bacillus, is the soil. The period of incubation for tetanus is longer than for infection with the gas-bacillus, the former appearing rarely before the seventh day, and the latter usually within two or three days after the injury.

Prophylactic measures against emphysematous gangrene are sufficiently obvious from the etiological factors which have already been considered. It is important in wounds of the character most frequently followed by this complication to search microscopically and by cultures for *Bacillus aerogenes capsulatus*. The examination of coverslips, stained by Gram, will usually suffice for a probable diagnosis. I have already cited instances in which this bacillus has been detected before the onset of emphysema and in which there is good reason to think prompt surgical treatment warded off severe infection. The possibility of infection from the intestinal canal, as well as from external sources, is to be borne in mind.

The cases were treated either by free incisions or by amputation or both. The results were better after amputation than after simple incisions. Of the cases of emphysematous gangrene affecting primarily the extremities, the recoveries numbered 68 per cent after amputation, and 33½ per cent after incision without amputation. Careful study of individual cases shows that amputation is by no means always necessary. Everything depends upon early recognition of the nature of the infection. Dr. Bloodgood,⁵⁶ from a relatively large experience, says: "If the infection is recognized early, and the destruction of the soft parts and bone is not extensive, free incisions with immediate continuous bath treatment should be tried. If the general symptoms of infection are not immediately relieved, amputation should be done. If, however, the infection is recognized late one should take no risk but amputate at once. . . . An early diagnosis will probably save life, and from many observations an amputation may not always be necessary."

A similar position as to prognosis and treatment is taken by Muscatello and Gangitano in their valuable paper on gaseous

⁵⁵ Semaine méd., 1890, p. 403.

⁵⁶ Progressive Medicine, 1899, IV, December, p. 174.

gangrene, in which they also emphasize the value of abundant irrigations with disinfectant and oxidizing solutions. In the service of Dr. Halsted at the Johns Hopkins Hospital the continuous bath treatment has been found useful. Hitschmann and Lindenthal are certainly mistaken in their assertion that incisions are usually without favorable effect and that early amputations offer the only chance of recovery. As pointed out by Thorndike and others recovery may follow amputation even when it is impossible to remove the whole of the diseased tissues.

GASEOUS ABSCESES.

The presence of gas in closed abscesses may be due to *Bacillus aërogenes capsulatus*.

It seems to me questionable whether Fraenkel's⁴¹ second case should be classified under emphysematous gangrene. In the region of the right elbow joint there was a painful fluctuating swelling from which on incision fetid pus mixed with gas-bubbles escaped. The subcutaneous tissue was partly necrotic. A similar swelling over the left shoulder joint was also incised. Besides the gas-bacillus, streptococci and long delicate bacilli appeared in the cultures. There is no statement concerning the causation of these abscesses. Passow's case was also a peculiar one. Following a superficial, suppurating wound of the right hand there appeared panophthalmitis with septicæmia, during which a crepitating swelling of the right shoulder and upper arm developed, from which on incision were evacuated gas and a brownish, fetid secretion, but no actual pus. Besides staphylococci a bacillus, believed by Passow to be identical with the gas-bacillus, was cultivated. I have included these two cases under the gaseous phlegmons or emphysematous gangrene, although at least the former seems to have been one of definite abscesses.

Soupault and Guillemot⁴² have recorded two cases of gaseous abscess, following hypodermic injections, due to the gas-bacillus. They call the organism "*Bacillus perfringens*" (Veillon and Zuber), but identify it with Fraenkel's *Bacillus phlegmones emphysematosæ*. Of the American work on *Bacillus aërogenes capsulatus* they have apparently never heard. In Soupault and Guillemot's first case a large abscess containing fetid pus and gas with the odor of sulphuretted hydrogen followed the injection of 40 cc. of 5 per cent common salt solution into the thigh of a patient with advanced and rapidly extending pulmonary tuberculosis. The injection, made September 7, was at once followed by a painful swelling of the thigh, over which the skin was reddened; on September 15, gas was detected; on September 25, 300 cc. of chocolate-colored, thick, viscid pus mixed with gas were aspirated, and 8 days later an incision, from which 200 cc. of reddish pus escaped, was made, after which the abscess slowly healed. Aërobic cultures were negative; in anaërobic cultures *Bacillus aërogenes capsulatus* (Veillon and Zuber's *Bacillus perfrin-*

gens) was obtained in pure culture. From the foul odor of the pus and gas, which is said to have been distinctly that of sulphuretted hydrogen, it is probable that, at least at some stage of the process, other microorganisms were associated with the gas-bacillus, which survived for nearly a month in the abscess.

The same authors report a second case of gaseous abscess which in this instance followed the injection of artificial serum into the abdominal walls of a child with grave typhoid fever. The abscess, which was opened by thermo-cautery, contained yellowish, viscid, inodorous pus. Three aërobic organisms, of which *Staphylococcus aureus* predominated, were found associated with *Bacillus aërogenes capsulatus*.

Soupault and Guillemot describe a third case of a young man, 19 years old, in whom a gangrenous phlegmon with extensive sloughing followed an injury of the left leg received in playing foot-ball. After the critical condition seemed to have passed, an emphysematous subcutaneous swelling appeared in the opposite, healthy leg near the inside of the knee. A hypodermic injection of salt solution had been made in the external part of the right thigh, but the authors do not consider that this had anything to do with the gaseous swelling, as the latter was too remote from the site of injection. They, therefore, attribute the gaseous phlegmon to transportation of bacilli by the circulation from the opposite extremity. *Bacillus aërogenes capsulatus* was found in pure culture. Recovery was uninterrupted.

Soupault and Guillemot emphasize the benign course of the affection in their three cases, as well as in other instances of gaseous abscess following hypodermic injections which they cite from published records. Conditions favoring the occurrence of such abscesses after these injections are the irritating quality of the fluids injected (ether, tincture of musk, camphor, acid solutions of morphine, concentrated saline solutions, etc.) and lowered general resistance of the patient produced by typhoid fever, tuberculosis, cancer, cholera, hæmorrhages, and other grave diseases. When death occurs, they think that it is usually attributable to the primary disease, not to the infection with the gas-bacillus.

I have included in my statistics of emphysematous gangrene 5 cases of gaseous phlegmon following hypodermic injection, 3 of these (Carroll 2, Dobbin 1) being of normal salt solution in puerperal women, and 2 (E. Fraenkel) being respectively of oil of camphor followed at once by ether in a patient after extirpation of a pyloric cancer, and of a solution in water of sulphuric acid and muriate of morphia in cholera. That the most unirritating of solutions may be followed by gaseous phlegmon is demonstrated by the three cases in which physiological salt solution was injected. Of these latter two died and one recovered after incision of the phlegmon. Both of Fraenkel's cases terminated fatally.

Including Soupault and Guillemot's 3 instances of gaseous abscess we have altogether 8 cases of gaseous abscess or phlegmon following hypodermic injections of various substances and caused by *Bacillus aërogenes capsulatus*, usually in association with other bacteria.

⁴¹ Ueber Gasphlegmonen, p. 15, Hamburg and Leipzig, 1893.

⁴² Bull. et mém. Soc. méd. d. hôp. de Paris, 1900, 3. S., XVII, p. 216.

Brieger and Ehrlich's⁶³ two observations of fatal gaseous phlegmon following the hypodermic injection of tincture of musk in typhoid fever are usually cited as the first instances of authenticated malignant œdema in man, but it cannot be said that the bacillus concerned was proven beyond doubt to be that of malignant œdema, and with our present knowledge of the etiology of this class of affections it is permissible to question the accuracy of the identification of the bacillus in these two cases, notwithstanding the high authority of the observers. In the case of gaseous abscess following the intramuscular injection of ether reported by Bucquet,⁶⁴ and in the two similar cases reported by Lauteret,⁶⁵ all three ending in recovery, no bacteriological examination was made.

It is evident from the foregoing cases that *Bacillus aërogenes capsulatus*, in combination usually with pyogenic bacteria, is the chief, if not sole, cause of the gaseous abscesses or emphysematous gangrene which occasionally follow hypodermic injections. Although in none of the cases reported has this bacillus been looked for in the fluids injected, the presumption is that it was present either in them or in the syringe, although there is a possibility of the introduction of this organism from the skin of the patients, and even of its conveyance by the circulation from the intestine to the site of issues damaged by the injection of irritating substances.

I shall refer subsequently to the occurrence of the gas-bacillus in abscesses without gas and to other manifestations of its pyogenic capacity.

UTERINE INFECTIONS.

Knowledge of *Bacillus aërogenes capsulatus* is of not less interest and importance to the obstetrician than to the surgeon. Infection of the puerperal uterus by this microorganism leads to a variety of morbid conditions, some comparatively mild, others of the utmost gravity.

The wide distribution of the gas-bacillus in the intestinal canal and the outer world renders as explicable the occasional presence of this bacillus in the female genital tract as that of the colon bacillus in the same situation. Lindenthal⁶⁶ found the gas-bacillus in the vagina without the presence of gas or other pathogenic effects twice out of six puerperal cases examined. According to the observations of others, Lindenthal's experience would seem to be exceptional. As with so many other pathogenic bacteria the mere presence of the organism upon exposed surfaces does not necessarily signify infection.

I shall consider the uterine infections by the gas-bacillus under the headings of emphysema of the fœtus, puerperal endometritis, physometra, emphysema of the uterine wall, and puerperal gas-sepsis, although these conditions may be associated with each other.

Emphysema of the Fœtus.—The occurrence of emphysema

in the dead fœtus in utero has been known for centuries,⁶⁷ but it was not until 1897, when Dobbin published his paper on "Puerperal Sepsis due to Infection with the *Bacillus aërogenes capsulatus*"⁶⁸ that the cause of this condition was determined to be invasion by *Bacillus aërogenes capsulatus*. In this case gas and the gas-bacillus were both recognized during the life of the patient in the fœtus, the placenta and the cavity of the uterus, and after death there was general gas-formation throughout the body.

Dr. Dobbin has kindly given me the notes of a second, unpublished case observed by him. He was called to see a woman in difficult labor, upon whom repeated attempts at delivery of a dead fœtus had been made. Upon examination he recognized crepitation of the caput succedaneum while the fœtus was still in utero. Upon delivery the fœtus was emphysematous with foamy organs. The gas bacillus was found in pure culture in the fœtus and mixed with other bacteria in the amniotic fluid. No gas was recognized in the uterus after delivery. The patient made a good recovery without evidence of sepsis.

Menge and Krönig⁶⁹ have observed three instances of fœtal infection by the gas-bacillus and have brought strong evidence that usually the invasion is through the mouth of the fœtus, the bacilli being taken into the lungs or stomach by inspiring or swallowing amniotic fluid. In their cases the bacilli were not found in the part of the umbilical cord attached to the placenta, but in Dobbin's first case this as well as the placenta itself was infected with the gas-bacillus. The amniotic fluid within the intact membranes, as is well known, is usually sterile, and only exceptionally becomes infected before rupture of the membranes, so that the infection of the fœtus from this source is generally after this rupture. As shown by Menge and Krönig, all grades of invasion of the fœtus by the gas-bacillus occur, so that there may be only a small amount of gas, and this limited to the lungs or the alimentary canal or both. The medico-legal importance of not mistaking for air this gas in the fœtal lungs produced by gas-bacilli should be emphasized.

As is well known, fœtal emphysema is usually unattended with danger to the mother. In two of the five cases due to *Bacillus aërogenes capsulatus* in my list the puerperium was even without rise of temperature, in two there was mild fever, but in Dobbin's first case there was rapidly fatal gas-sepsis.

will be considered cases of acute uterine infection with the

Puerperal Endometritis.—Under the heading "gas-sepsis"

⁶⁷ It is usually stated that this condition was known to Celsus, but he does not expressly mention the presence of gas, although this is to be inferred. In the chapter on extraction of the dead fœtus, he says: "Solet etiam evenire, ut is infans humore distendatur, exque eo profluat fœdi odoris sanies." Milligan's "Celsus," p. 394, Edinburgh, 1831.

⁶⁸ Bulletin of the Johns Hopkins Hospital, 1897, VIII, p. 24.

⁶⁹ Bakteriologie des weibl. Genitalkanales, Teil II, p. 167, Leipzig, 1897.

⁶³ Berliner klin. Woch., 1882, XIX, p. 661.

⁶⁴ Thèse, Paris, 1883.

⁶⁵ Thèse, Paris, 1898.

⁶⁶ Wiener klin. Wochenschr., 1897, pp. 3 and 35.

gas-bacillus followed by invasion of the blood and organs by this organism. Here it may be mentioned that *Bacillus aërogenes capsulatus* may be present in the uterus, usually in association with other bacteria, in both mild and severe cases of puerperal endometritis without the recognition of gas in the foetus, or the uterine cavity, or wall. An example of such a case is an unpublished one in the service of Dr. J. Whitridge Williams, of which the notes have been furnished me by Dr. Dobbin. A woman with rachitic pelvis, upon whom delivery by forceps had been attempted before admission to the Johns Hopkins Hospital, was there delivered by craniotomy. There was no gas in the foetus. Forty-eight hours later *Bacillus aërogenes capsulatus*, together with streptococci, was found in the uterine lochia. No gas was detected. The patient developed fever, but recovered.

In two cases, one reported by Dobbin⁷⁰ and the other by Blumer,⁷¹ the gas-bacillus, although not identified with absolute certainty, was probably present in the puerperal uterus in association with the typhoid bacillus.

Physometra.—Distension of the uterine cavity with gas (physometra or tympany of the uterus) was present in Dobbin's first case, already cited, and is often associated with emphysema of the dead foetus, but may occur without the latter and even in the non-pregnant uterus. This curious condition was formerly ascribed to entrance of air or to ordinary putrefaction,⁷² but it is now known to be the result of the activity of gas-producing bacilli.

Since the observations of Lindenthal,⁷³ reported in 1898, it cannot be doubted that *Bacillus aërogenes capsulatus* is the chief cause of physometra. He found this bacillus in five cases during life and reproduced the condition experimentally in guinea-pigs. He is justly skeptical of the correctness of the previous reports of Gebhard⁷⁴ concerning the agency of the colon bacillus in generating gas within the uterus. We know from Theobald Smith's investigations that the colon bacillus can produce gas only from carbohydrates, whereas it is the most distinctive biological attribute of our gas-bacillus that it can produce gas from proteids. Until it has been shown that the amniotic fluid and uterine contents may under any conditions contain enough carbohydrate to explain the development of gas by the colon bacillus there is every reason to question the claims for this bacillus as a cause of tympany of the uterus.⁷⁵

My list of cases contains 10 instances of physometra in

which *Bacillus aërogenes capsulatus* was demonstrated. Although as some of our cases show, this condition may be associated with invasion of the bacilli into the wall of the uterus and by acute gas-sepsis, these occurrences are exceptional and the prognosis is in general a favorable one. Most of the cases furnish a good illustration of the resistance of living human tissues to the action of the gas-bacillus. Doubtless in these cases the bacilli grow simply in the amniotic fluid after rupture of the membranes, and in the dead foetus these offering no vital resistance, whereas we must suppose that the intact uterine wall offers ordinarily an effective resistance to the invasion and multiplication of the gas-bacillus. That occasionally the bacilli may find other dead material in the uterus, as in sloughing myomata and cancers, is evident from the histories of some cases of physometra.

Emphysema of the Uterine Wall.—Far graver in significance is septic emphysema of the uterine wall, of which Halban⁷⁶ has recently reported an interesting case due to *Bacillus aërogenes capsulatus*. Graham, Steward and Baldwin and P. Ernst were the first to demonstrate this bacillus in this condition, their papers, to which reference has already been made, appearing simultaneously in August, 1893. Eleven instances of emphysema of the wall of the uterus, all puerperal, have been reported, of which 5 were recognized during life. In all but Halban's case there was also physometra, and this would seem to be a necessary accompaniment unless the cervical canal is open so as to permit the escape of the gas from the uterine cavity. All of the cases were fatal, and in most gas was found at autopsy in the blood and internal organs.

Subperitoneal emphysema is a condition which has been observed after rupture of the uterus, Dischler⁷⁷ having collected reports of 14 cases. In most instances this has been attributed to entrance of air, but I think that it is safe to predict that the gas-bacillus will be found in similar cases in the future, if proper methods for its detection are employed. I know, however, of no instance of this condition in which it has been looked for.

Puerperal Gas-Sepsis.—I have adopted from Halban the term "gas-sepsis" as a convenient one—although, perhaps open to criticism—to designate the important group of fatal puerperal cases in which gas-bubbles are found at early autopsies in the heart and vessels and often also in the organs and tissues under conditions where we must suppose that gas-bacilli and possibly gas have passed from the uterus into the circulation during life.⁷⁸ Here in my opinion belong most of the cases which have been reported as deaths due to the entrance of air into the uterine veins. This opinion which I expressed in my first communications on the gas-bacillus in 1891 and 1892, received prompt confirmation in the papers

⁷⁰ Am. Journ. Obstetrics, 1898, XXXVIII, p. 185.

⁷¹ Ibid., 1899, XXXIX, p. 42.

⁷² The older hypotheses and records on physometra and emphysema of the foetus are fully presented by Staude, Zeitschr. f. Geb. u. Gynäk., 1878, III, p. 191.

⁷³ Monatsschr. f. Geb. u. Gynäk., 1898, VII, p. 269.

⁷⁴ Zeitschr. f. Geb. u. Gynäk., 1893, XXVI, p. 480, and 1897, XXXVII, p. 132.

⁷⁵ Halban (Monatsschr. f. Geb. u. Gynäk., 1900, XI, p. 102) states that he has found lactose once in the amniotic fluid of a normal puerpera. Further studies of this subject are needed.

⁷⁶ Monatsschr. f. Geb. u. Gynäk., 1900, XI, p. 88.

⁷⁷ Arch. f. Gynäk., 1898, LVI, p. 199.

⁷⁸ Gas-sepsis in this sense occurs also in other than uterine infections with the gas-bacillus.

of Graham, Steward and Baldwin and of P. Ernst in August, 1893, and has since been strengthened by other similar observations. Cases described by Wendeler⁷⁹ as sepsis acutissima belong also in the same category.

My list includes 13 puerperal cases in which gas-bubbles and the gas-bacillus were found at autopsy in the blood or organs; but in only 7 of these does it seem to me conclusive or extremely probable that the infection occurred during life.⁸⁰ The most remarkable of these cases is that reported by Graham, Steward and Baldwin of a woman, upon whom abortion had been recently produced, who during the four hours immediately preceding death became emphysematous over nearly the whole body. At the autopsy gas and gas-bacilli were found everywhere throughout the body. In Dalton and Bremer's⁸¹ case, also one of criminal abortion, an emphysematous swelling of the arm and pectoral region was likewise recognized during life. These cases are of importance as demonstrating the invasion of the body by the gas-bacillus from the uterus while the blood is still circulating. In Halban's and Dobbin's cases gas was also recognized during life within the wall or cavity of the uterus.

In the majority of cases of puerperal gas-sepsis there has been some operative interference preceding infection, such as criminal abortion, forced delivery for placenta prævia or other causes, or the manipulations of an unskilled midwife. The fulminating character of the infection, death being sometimes very sudden, is a notable feature of many of the cases.

In a case of attempted criminal abortion reported by Perkins⁸² the patient, according to the statement of the practitioner in whose office death occurred, died suddenly, and at the autopsy twelve hours later in cold weather, gas was found in the vena cava, heart, and other vessels, with evidences of injury to the pregnant uterus. The case was reported by Perkins as one of death from air-embolism, and certainly with much and even more plausibility than most cases thus reported. After the publication, Dr. Perkins, upon the request of Dr. Dobbin, was so good as to send the uterus, well preserved in alcohol, to my laboratory where Dr. Dobbin demonstrated in the uterine vessels and tissue bacilli morphologically and in staining reaction identical with *Bacillus aerogenes capsulatus*.⁸³

I would not be understood to deny the possibility of the occurrence of fatal air-embolism from the uterus. A very few of the reported cases are difficult to interpret upon any

other supposition, but I do claim that the foundations of this doctrine have been seriously shaken by our discovery and investigations of the gas-bacillus, and that no case, however plausible, can be considered as positively proven without a satisfactory bacteriological examination. The limitation of gas to the right heart and adjacent vessels may occur from invasion by the gas-bacillus, and is not, as often represented, peculiar to air-embolism. Did we not know how long it takes new knowledge, especially that originating in this country, to penetrate throughout the medical world, it would be amazing that cases should still continue to be reported, as they are,⁸⁴ of deaths ascribed to air-embolism without any bacteriological examination or even any reference to the possibility of any other explanation. I am not aware that in any instance of alleged air-embolism, a bacteriological examination has been made, which would exclude the presence of gas-forming bacteria.

Whether, as suggested by Staude, in any of the cases with gas within the uterine cavity, death is attributable to gaseous embolism, is, I think, an open question. It is possible, although I know of no proof of it, that in some of the cases of sudden death during or immediately after some manipulation or operation on the pregnant uterus and attributed to air-embolism, gas, generated by bacteria, may have existed under pressure within the uterine cavity and have entered wounded veins in sufficient amount and so suddenly as to have caused death.

To what extent the free gas found in the blood-vessels, heart and internal organs, even very soon after death from what has been described as puerperal gas-sepsis, is there during life, is a question difficult to answer. I have already considered this subject, and in this connection shall again emphasize the importance of caution in interpreting the presence of gas in these situations as a vital phenomenon, although there is evidence that it may be such.

INFECTIONS OF THE URINARY TRACT.

There is evidence that the urinary tract may not only be a portal of entrance for the gas-bacillus into the circulation or adjacent tissues but also be itself the seat of infection by this organism. Unfortunately for the decisive interpretation of many of these cases, *Bacillus aerogenes capsulatus* has, so far as I am aware, hitherto been found in the urinary tract only after death, although in some instances so soon thereafter and under such conditions that its presence during life cannot be doubted.

I have already called attention to instances of emphysematous gangrene following external urethrotomy and other operations on the urinary passages.

⁸⁴ Zorn (Münch. med. Woch., 1898, p. 567) may be cited as an example. Hübl (Wiener klin. Woch., 1900, XII, p. 111) has also recently reported two instances of alleged air-embolism—placenta prævia—without any bacteriological examination. He assumes incorrectly that the distribution of the gas at autopsy is a decisive point as between air-embolism and gas-sepsis.

⁷⁹ Monatsschr. f. Geb. u. Gynäk., 1896, IV, p. 581.

⁸⁰ These are the cases reported by Graham, Steward and Baldwin, P. Ernst, Menge and Krönig, Dobbin, F. C. Wood (Med. Record, Apr. 15, 1899), Cesaris-Demel, and Halban, to whose papers references have already been given.

⁸¹ Am. Journ. Med. Sc., 1888, XCV, p. 594. This infection, though attributed to the bacillus of malignant oedema, was probably due to the gas-bacillus.

⁸² Boston Med. and Surg. Journ., 1897, CXXXVI, p. 154.

⁸³ Dobbin has reported the results of his examination with further notes of this case in the Monatsschr. f. Geb. u. Gynäk. 1897, p. 375.

Among the cases of general invasion of the blood and organs (foamy organs) by the gas-bacillus observed by myself and others are several in which the portal of entry was the urethra, bladder or other part of the urinary tract.⁸⁵ In a case of urethral stricture with cystitis, for which perineal section had been done, reported by Welch and Flexner, gas-bacilli were found *three-quarters of an hour after death* in large numbers in the bladder, ureters and renal pelvis, and a few gas-bubbles and gas-bacilli were already present in the blood of the right ventricle. In Howard's case of meningitis caused by the gas-bacillus, to be cited subsequently, he considers that the portal of entry was the urinary tract.

Gas, generated by *Bacillus aerogenes capsulatus*, has been found in the urinary passages in 6 cases which have come to my notice.⁸⁶ The gas may be either free in the cavity of the bladder, ureters or renal pelvis, or contained within submucous blebs, or in both situations.

Welch and Flexner⁸⁷ have reported an instance of pneumaturia in a diabetic man in whom, six hours after death, without trace of cadaveric decomposition, the urinary bladder was found filled with frothy urine containing *Bacillus aerogenes capsulatus* in pure culture. This case indicates that the colon bacillus and *Bacillus lactis aerogenes* are not the sole causes of pneumaturia in diabetics. Dr. Flexner has given me the notes of a second case of pneumaturia upon which he made the autopsy at the University Hospital, Philadelphia. This was of a patient with chronic cardiac disease who had been catheterized twenty-eight hours before admission and who died thirty hours after admission. At the autopsy, made one hour and a half after death, about 60 cc. of frothy urine were found in the bladder from which *Bacillus aerogenes capsulatus*, together with *Staphylococcus aureus* and *Streptococcus pyogenes* (no colon bacilli), was cultivated. Neither gas nor gas-bacilli were found elsewhere in the body. The mucous membrane of the bladder was oedematous. There can be little doubt that in this case the gas-bacillus was introduced by the catheter into the bladder.

In one of Welch and Flexner's cases (Case XVIII) of hypertrophied prostate with pyoureter and pyonephrosis, the renal pelvis and ureters were found at autopsy distended with gas and containing pus mixed with bubbles of gas. Small gas-cysts were present in the mucous membrane of the renal pelvis. Neither gas nor gas-bacilli were present outside of the urinary organs. In this case cocci and colon bacilli were associated with the gas-bacillus.

In a case of Dr. Kelly's, of which the full records have been given me by Dr. Miller,⁸⁸ there was pneumaturia demon-

strated by cystoscopic examination and ureteral catheterization to come exclusively from the inflamed left renal pelvis and ureter. Among cocci and other bacteria were found on coverslips bacilli morphologically resembling *Bacillus aerogenes capsulatus*, but unfortunately no anaërobic culture were made. None of the bacteria which grew aerobically produced gas in lactose-agar. This case is interesting in demonstrating that the gas may come exclusively from one renal pelvis and ureter, but the microorganism producing the gas was not satisfactorily demonstrated. It seems certain that it was an anaërobic organism, and from the microscopical appearances may have been the gas-bacillus.

The subject of submucous gas-cysts will be considered subsequently; but here it may be mentioned that besides the gas cysts in the renal pelvis noted by Welch and Flexner in the case already cited, Goebel found gas-blebs, containing in pure culture *Bacillus aerogenes capsulatus*, beneath the mucous membrane of the urinary bladder, without gas elsewhere in the body, and Dunham has reported a like condition of the bladder in a case of emphysematous gangrene with general invasion of the blood and organs by the gas-bacillus.

Bacteria have been found in emphysema of the bladder (cystitis emphysematosa) also by Eisenlohr,⁸⁹ Camargo,⁹⁰ and Kedrowsky,⁹¹ but it is impossible from the authors' descriptions to identify their bacteria. Kedrowsky considers that the bacillus isolated by him is allied to *Bacillus aerogenes capsulatus*, but less sensitive to oxygen. Perhaps it was Sanfelice's *Bacillus pseudo-oedematis maligni*, to which I have already referred, but Kedrowsky's description of his cultures hardly inspires confidence in their purity.

Welch and Flexner and Howard have reported finding the gas-bacillus, in association with other bacteria, in inflammatory lesions of the bladder, renal pelvis and kidneys, without the detection of gas. Howard considers that in one of his cases the bacillus was concerned in the etiology of suppurative lesions of the kidneys but in this case the colon bacillus and *Streptococcus pyogenes* were also present.

INFECTIONS DERIVED FROM THE GASTRO-INTESTINAL CANAL.

Mention has already been made of the frequent, if not constant, presence of *Bacillus aerogenes capsulatus* in the intestinal canal, of gaseous phlegmons originating from this source, and of the readiness with which intestinal bacteria may gain access to the genito-urinary tract.

The intestine is by far the commonest source of the gas-bacilli found together with gas-bubbles in the blood and organs at autopsies. This invasion may occur either with or without definite intestinal lesions, and is probably in the majority of cases an agonal or post-mortem event. The mode of distribution and spread of the bacilli in these cases has

⁸⁵ Such cases are reported by Welch and Flexner, Goebel, Dunham and Howard in papers already cited.

⁸⁶ These do not include some instances of very extensive post-mortem emphysema of the organs with gas everywhere throughout the body.

⁸⁷ Case XIII of our list in *Journal of Experimental Medicine*, 1896.

⁸⁸ This case is briefly reported by Kelly and MacCallum, *Journ.*

Amer. Med. Assoc., 1898, XXXI, p. 376, whose paper may be consulted for the full literature of pneumaturia.

⁸⁹ Ziegler's Beitr., 1888, III, p. 101.

⁹⁰ Thèse de Genève, 1891.

⁹¹ *Centralbl. f. allg. Path. u. path. Anat.*, 1898, IX, p. 817.

been well described by Howard,⁹² whose experience has been exceptionally large with this class of affections. Especially demonstrative of invasion of gas-bacilli from the intestine, usually post mortem, is the occurrence of gas-bubbles limited to the neighborhood of the intestine, as in the intestinal wall, within the portal or mesenteric veins, or lymphatics, in the subperitoneal tissues, mesentery and omenta, around the pancreas, in the mesenteric gland, and especially in the loose tissue near the gall-bladder and in the porta of the liver, without gas in more remote situations. I have seen examples of each of these occurrences in very early autopsies without ordinary cadaveric decomposition.

Local Gastro-intestinal Lesions.—Interstitial emphysema of the gastro-intestinal wall will be considered subsequently.

Howard has described several cases with larger or smaller areas of superficial necrosis of the mucous membrane of the stomach and intestine, in which gas-bacilli were present in large numbers. These areas, which may occur either with or without gas-cysts, are found most frequently beneath the folds of the valvulae conniventes and are characterized by absence of nuclear staining and disintegration of the cells and tissue, usually without marked inflammatory reaction.

Bacillus aërogenes capsulatus may undoubtedly be a cause of meteorism. Instances of this are reported by Welch and Flexner and by Howard.

Pneumo-peritonitis with and without Perforation.—My records include 13 cases of diffuse peritonitis in the exudate of which *Bacillus aërogenes capsulatus* was found. Eleven of these were in autopsies made either by Dr. Flexner or myself, having already been published by us in 1896. The remaining 2 cases (both being perforations of gastric ulcers) have been reported by Page,⁹³ and by Pratt and Fulton.⁹⁴ It was the observation of these cases which first called my attention to the frequent presence of the gas-bacillus in the intestine.

Ten of the cases were perforative and 3 were non-perforative. Of the former 4 were the result of perforation of phoid ulcers, 4 of gastric ulcers,⁹⁵ one of strangulated, gangrenous intestine and one of a cancerous ulcer of the duodenum. In the last case (autopsy fourteen hours after death) the exudate was sero-fibrinous and the gas-bacillus was found in pure culture⁹⁶ and abundantly in the peritoneal cavity and

was absent from other organs and the blood. In the other perforative cases the gas-bacillus was mixed with other bacteria, although in some instances it predominated. In all of the cases the abdomen was greatly distended with gas and usually there was great tympanites.

I attach especial importance to the case fully reported by Welch and Flexner,⁹⁷ in which we brought conclusive evidence of the occurrence of pneumoperitonitis without perforation, the first of the kind on record in which similar proof was obtained. The presence of gas in the peritoneal cavity was recognized during life. Since our publication a similar case has been observed by Dr. Flexner in Manila, who has kindly furnished me the notes. At the autopsy, twelve hours after death, there was found hæmorrhagic infarction of the lower part of the ileum and adjacent part of the large intestine, caused by the passage of this part of the intestine through a hole in the mesentery. The peritoneal cavity was greatly distended with gas which burnt with a pale, blue flame. There was a large amount of frothy, bloody serum in the peritoneal cavity together with a fibrinous exudate. The most careful examination showed no perforation. *Bacillus aërogenes capsulatus* was obtained in pure culture and abundantly from the peritoneal fluid. Gas was absent from the blood and other organs.

We have found the gas-bacillus, mixed with other bacteria, twice in circumscribed, gas-containing, intraperitoneal abscesses resulting from perforation of the appendix vermiformis.

Hepatic and Biliary Infections.—The development of gas in the liver is so striking a phenomenon in most autopsies where the gas-bacillus and free gas are found in the blood and organs that P. Ernst used the term "Schaumleber" for the title of his article on the gas-bacillus, published a year after the paper by Welch and Nuttall, in which we first directed attention to the subject of foamy organs and the gas-bacillus.⁹⁸ I have already considered the general subject of gas-bubbles in the blood and organs, and wish here to call attention especially to infections of the gall-bladder and biliary passages by *Bacillus aërogenes capsulatus*.

In cases of foamy liver gas may be found in the bile-ducts and gall-bladder, but my experience is that, when the gas-bacilli reach the liver through the blood-vessels, the appearance of gas in these situations is a rather late occurrence and met chiefly in advanced cases. In contrast to these cases are the observations of gas in the biliary passages, associated sometimes with definite lesions of the bile-ducts and liver, where the evidence is that the gas-bacilli entered from the

⁹² Op. cit., p. 491.

⁹³ Canada Lancet, May, 1900.

⁹⁴ Boston Med. and Surg. Journ., June 7, 1900, p. 599.

⁹⁵ Welch and Flexner have reported an instance of peritonitis from perforated gastric ulcer in a rabbit, in which the gas bacillus was found.

⁹⁶ The purity of the culture in this case is explicable by the results of Cushing and Livingood's interesting bacteriological and experimental studies of the duodenal flora published in Contributions to the Science of Medicine, Dedicated by his pupils to William Henry Welch on the 25th Anniversary of his Doctorate, 543, Baltimore, 1900.

⁹⁷ Op. cit., p. 35.

⁹⁸ Heydenreich's paper on "Emphysem der Leber" (Centralbl. f. Bakter., 1897, XXI, p. 305) may be mentioned as a curiosity. He had never heard of the gas-bacillus or of any other investigation of the subject later than 1872. In contrast to this is the interesting article of P. Bernhardt on pneumathæmia and foamy organs with full consideration of the recent literature. Deutsche med. Woch., 1900, p. 83.

intestine directly into these passages. Two such cases have been reported by Howard,⁹⁹ and I have observed two cases.

Pratt and Fulton¹⁰⁰ report a remarkable case of cancer of the common bile-duct and pancreas in which cholecystotomy was performed, the edges of opening in the gall-bladder being stitched to the abdominal walls. At the autopsy the liver was found studded with minute abscesses with greenish translucent walls. In coverslips, sections and cultures *Bacillus aërogenes capsulatus* was found in pure culture in these small biliary abscesses, but there was no gas in the abscesses, the liver, blood, or other organs. A somewhat similar case, in which cholecystenterostomy for gall-stones had been performed, was previously reported by Nicholls¹⁰¹ from Adami's laboratory. Here also multiple miliary abscesses containing the gas-bacillus were found in the liver, but in this case gas was present in the liver, as well as in the blood and other organs, the autopsy being six hours after death. Larkin¹⁰² has likewise reported a case of hæmorrhagic pancreatitis with fat necroses and small, multiple hepatic abscesses with gas-holes in the liver, from which *Bacillus aërogenes capsulatus* was isolated. The autopsy was eight hours after death.

Hintze¹⁰³ has recorded a post-mortem observation of gas in the inflamed bile-ducts with cholelithiasis. He cultivated only the colon bacillus, but it does not appear that he made anaërobic cultures.

From the foregoing cases it is to be inferred that the gas-bacillus may invade the bile-ducts and gall-bladder from the intestine, and sometimes during life, and that it may not only produce gas but also necroses and purulent inflammation. The presence of gall-stones, cancer of the bile-ducts and operations on the gall-bladder favor this mode of infection.

Rist¹⁰⁴ found the gas-bacillus (*Bacillus perfringens*), without gas or other lesion attributed to it, in an extirpated gall-bladder containing a calculus and clear viscid fluid.

INTERSTITIAL EMPHYSEMA OF THE GASTRO-INTESTINAL, GENITO-URINARY AND BILIARY TRACTS.

One of the most interesting lesions produced by *Bacillus aërogenes capsulatus* is the formation of submucous or subserous gas-cysts or blebs, of which the earliest examples attributed to this organism were reported by P. Ernst, Goebel, and Welch and Flexner. They are sufficiently common to have been observed by nearly all investigators who have had much experience with the gas-bacillus in human beings. My list of cases includes 25 instances of this condition, of which 5 were of the stomach, 11 of the intestine (far oftener of the small than the large intestine), 5 of the gall-bladder and bile-

ducts, 3 of the urinary bladder, 1 of the renal pelvis, and 1 of the vagina. The majority of the cases were observed by Flexner, Howard, and myself, and in all the gas-bacillus was demonstrated. The case of emphysema of the vagina was reported by Lindenthal.¹⁰⁵

These gas-cysts vary in size from microscopic dimension to large blebs. They are most common in the submucous coat, but may be present in the mucous membrane, the muscular coat or beneath the serous covering, in fact, in any part of the membranous wall. They may be few or in enormous numbers, in groups or scattered. In one of our cases the whole small intestine from the duodenum to the ileocecal valve was studded with small gas-cysts. Gas-cysts of the same general character may be found in the mesentery and omenta.

These gas-cysts are in their inception simply such gas-holes as we are already familiar with in the liver and other organs, in cases of local or general invasion with the gas-bacillus. They indicate a foamy or emphysematous condition of the walls of the stomach, intestine, gall-bladder, bile-ducts, urinary bladder and vagina, due to the invasion into these parts of the gas-bacillus.

The condition of the walls of the blebs and of the surrounding tissues varies. Some of the cavities are round and their walls smooth, others are irregular in shape and have ragged walls. They may correspond to dilated lymphatics, but more frequently they do not represent dilatation of any perforated channels. There may be communication between adjacent cavities, but oftener the cysts are distinct from each other. The tissue in the immediate neighborhood of the cavities may present no alteration not explicable by the mechanical pressure of the gas, or it may show necrosis in varying degree and extent. Inflammatory changes or cellular reaction which could be reasonably referred to the presence of the cysts or of the gas-bacilli causing them were not noted. Sometimes a little coagulated, homogeneous or granular material is present in sections of the cysts in hardened tissues, as indeed may often be found in gas-holes in the organs.

In sections stained by Gram there is usually no difficulty in demonstrating the relation of the gas-bacilli to the cysts. The bacilli may be in masses in the walls of the cysts, but sometimes they are not more numerous there than in the tissue at a distance from the gas-blebs, and occasionally it requires some searching to find them. By anaërobic methods the gas-bacillus can be cultivated from the cysts or the adjacent tissue.

All of the instances of submucous and subserous gas-cysts in my list were observed post mortem. In the larger number of cases gas-bacilli and gas-bubbles were more or less widely distributed in the blood and organs, but without evidences of ordinary post-mortem decomposition. There are, however, several cases in which these gas-cysts in various situations were the sole manifestation of the presence of the gas-bacillus in the body. Howard has shown that if careful, systematic

⁹⁹ Contributions to the Science of Medicine, Dedicated by his pupils to William Henry Welch on the 25th Anniversary of his Doctorate, pp. 475 and 476, Baltimore, 1900.

¹⁰⁰ Boston Med. and Surg. Journ., June 7, 1900, p. 599.

¹⁰¹ Brit. Med. Journ., 1897, II, p. 1844.

¹⁰² Med. Record, 1898, LIII, p. 354.

¹⁰³ Münch. med. Woch., 1895, XLIII, p. 209.

¹⁰⁴ Thèse, Paris, 1898.

¹⁰⁵ Wiener klin. Woch., 1897, pp. 3 and 35.

search is made for areas of necrosis and minute gas-cysts due to *Bacillus aërogenes capsulatus* in the stomach and intestine, these lesions can be found much more frequently than has been supposed.

It is, with our present information, a difficult matter to say how many of these cases the emphysematous state existed before death. It is certain that, at least in the great majority of cases in my list, the emphysema was not the result of ordinary post-mortem decomposition. In a large number of the cases the autopsy was made within a few hours after death. Toward, in one of his cases of gas-cysts, limited to the intestine, made the autopsy one hour after death. I have already emphasized the importance of great caution in interpreting the vital processes the various gaseous conditions of parts and organs not open to inspection during life, even when autopsies are made soon after death and there is entire absence of putrefaction, and I can only repeat this caution here. Mere absence of nuclear staining around gas-holes I do not regard as proof of their origin during life.

It would lead altogether too far to enter here into a discussion of the general subject of submucous gas-cysts concerning which there is a large literature, the principal references to which will be found in the articles of Eisenlohr,¹⁰⁶ Camargo,¹⁰⁷ Winands,¹⁰⁸ Orlandi,^{108a} Dupraz¹⁰⁹ and Lindenthal.¹¹⁰ It would appear from a study of the records of the subject that anatomically different conditions have been described under the designation "gas-cysts" (*cystides aëriferæ*). Some have been apparently of long standing and show chronic inflammatory changes in the walls of the cysts and the surrounding tissues. The most voluminous records relate to the gas-cysts of the vagina (*kolpohyperplasia cystica* of Winckel, *emphysema vaginæ* of Eppinger).

At present we have no warrant to identify the more chronic gas-cysts with thickened walls with the more acute emphysematous condition which I have described as referable to *Bacillus aërogenes capsulatus*. Nevertheless the former are probably of bacterial origin also, although I am unable to accept the bacteriological findings of Eisenlohr, Camargo, Orlandi and Dupraz as at all convincing, for they made no use of anaërobic methods of cultivation. It is quite possible that *Bacillus aërogenes capsulatus* is concerned also in the etiology of the gas-cysts of long standing; certainly it is important to apply hereafter anaërobic cultural methods to their study. Lindenthal has no hesitation in identifying the emphysema of the vagina observed by him post mortem and from which in a single case he cultivated what he chooses to call *Bacillus emphysematis vaginæ* (in reality our *Bacillus aërogenes capsulatus*) with Winckel's *kolpohyperplasia cystica*, but, while

he may be correct, further observations are needed before their anatomical and etiological identification can be accepted.

The only instance in which gas-cysts of the human intestine have been recognized during the life of the patient is reported by Hahn,¹¹¹ who found them in large number upon opening the abdomen. It is to be regretted that no thorough bacteriological examination of this case was made.

In my original communication on the gas-bacillus I ventured the surmise that the bacillus found by E. Fraenkel¹¹² in hardened sections from a case of gastritis emphysematosa might be identical with *Bacillus aërogenes capsulatus*, and this suspicion has gained in probability by Goebel's statements based upon a re-examination of the sections, his work having been done under Fraenkel's supervision.

Notwithstanding an effort at compression, so much space has been occupied in the presentation of the foregoing subdivisions of our subject, which in less than a decade has grown to considerable magnitude, that I shall only summarize very briefly a few remaining topics, although all deserve fuller treatment.

Pulmonary and Pleural Infections.—To the two instances of invasion of the lungs by the gas-bacillus reported by Welch and Flexner, I can add the cultivation of this organism from a gangrenous lung by Dr. Flexner in my laboratory. It has been found also by Guillemot¹¹³ and Rist¹¹⁴ in pulmonary gangrene.

Of much importance is Levy's¹¹⁵ demonstration of *Bacillus aërogenes capsulatus* as a cause of pneumothorax without perforation. This case and those of pneumoperitonitis without perforation to which I have already referred have settled affirmatively the long standing controversy concerning the possibility of the generation of gas within closed serous sacs during life. Nicholls¹¹⁶ has reported an instance of pneumothorax and pneumopericardium without perforation in which the gas-bacillus was probably present. Rendu and Rist¹¹⁷ also isolated the gas-bacillus (*Bacillus perfringens*) in a case of putrid pleurisy with gas. May and Gebhart¹¹⁸ and Finley¹¹⁹ attribute their two cases of pneumothorax without perforation to the colon bacillus, but in neither were anaërobic cultures made. It is important that in all gaseous affections anaërobic should be searched for.

Bacillus Aërogenes Capsulatus in the Blood during Life.—

¹¹¹ Deutsche med. Woch., 1899, p. 657.

¹¹² Virchow's Archiv, 1889, CXVIII, p. 526.

¹¹³ Thèse, Paris, 1899.

¹¹⁴ Thèse, Paris, 1898.

¹¹⁵ Arch. f. exp. Path. u. Pharm., 1895, XXXV, p. 335.

¹¹⁶ Loc. cit.

¹¹⁷ Bull. et mém. Soc. méd. d. hôp. de Paris, 1899, 3. S., XVI, p. 133.

¹¹⁸ Deutsches Arch. f. klin. Med., 1898, LXI, p. 323.

¹¹⁹ Philadelphia Monthly Med. Journ., 1899, I, p. 569.

¹⁰⁶ Ziegler's Beiträge, 1888, III, p. 101.

¹⁰⁷ Thèse de Genève, 1891.

¹⁰⁸ Ziegler's Beiträge, 1895, XVII., p. 38.

^{108a} Gazz. med. di Torino, 1896, XLVII, p. 781.

¹⁰⁹ Arch. de méd. expér., 1897, IX, p. 282.

¹¹⁰ Wiener klin. Wochenschr., 1897, pp. 3 and 35.

Extremely interesting is the demonstration by Gwyn,¹²⁰ both by coverslip specimens and by cultures, on repeated examinations, of *Bacillus aërogenes capsulatus* during life in the blood of a patient, in the Johns Hopkins Hospital, with chorea insaniens and acute endocarditis. I had the opportunity of examining his cultures, which were entirely typical. The patient died but unfortunately no autopsy could be obtained. There was no evidence during life of free gas in the blood or tissues. The case is of importance as demonstrating that gas-bacilli may be in the circulating blood for days in sufficient number to be demonstrable both microscopically and culturally without evidence of free gas. I have already expressed my suspicion that Achaume's anaërobic bacillus, which has likewise been cultivated from the blood, as well as from the tissues, of several cases of acute articular rheumatism, is identical with *Bacillus aërogenes capsulatus*.

Presence of Bacillus Aërogenes Capsulatus without Gas.—In this connection I may say that the gas-bacillus may be present and even multiplying within the human body without the production of gas. Certain organs, above all the liver, offer much more favorable pabulum for the generation of gas than do others, but even in the liver the bacilli may be present without gas. I have found gas-bacilli in clumps within the spleen and kidney, surrounded by areas of necrosis, without recognizable gas.^{120a} I have already cited the demonstrations by Cushing and by Pratt and Fulton of the gas-bacillus in small abscesses without gas, the observation of the latter being particularly complete and satisfactory. Rist¹²¹ has cultivated the gas-bacillus (*Bacillus perfringens*) from cases of fetid otorrhœa and of mastoid abscess. He does not mention the presence of gas in these cases. I have already cited his isolation of this bacillus from the gall-bladder which contained no gas.

Dr. Harris in my laboratory isolated the gas-bacillus in pure culture from an abscess containing blood and pus in the neck of a dog, following an operation on the jugular vein. There was no gas in the abscess. Aërobic cultures were entirely negative. These observations, however, are not the only ones demonstrating that the gas-bacillus may under certain circumstances and in certain situations manifest pyogenic capacity.

¹²⁰ Bulletin of the Johns Hopkins Hospital, 1899, X, p. 134.

^{120a} Cesaris-Demel's (loc. cit.) opinion that generation of gas in the tissues is merely a putrefactive process pertaining not to any particular kind of microorganism but to irreparable necrosis or damage of the tissues, whereby they become the prey of indifferent gas-producing bacteria, is not proven by his own observations and is opposed by many facts described in this paper.

¹²¹ Thèse, Paris, 1898.

Meningitis. Pyogenic Capacity of Bacillus Aërogenes Capsulatus.—Howard,¹²² in April, 1899, reported a case of acute fibrino-purulent meningitis, following operation for urethro-perineal fistula. *Bacillus aërogenes capsulatus* was found in pure culture in the meningeal exudate. Likewise Hitschmann and Lindenthal¹²³ have recorded another convincing example of acute cerebral meningitis, following fracture of the occipital bone, in which the gas-bacillus was found unmingled with other bacteria. These authors call attention to the pyogenic power of the gas-bacillus when it attacks the meninges, but, as already shown, the same power may be manifested elsewhere.

Cavities in the Brain.—Finally I would call attention to Renling and Herring's¹²⁴ and Howard's studies of cavities in the brain produced by *Bacillus aërogenes capsulatus* and to the light which their observations shed upon certain obscure examples of cerebral cavities previously reported.

In this excursion into pneumato-pathology I have invited you to the survey of fields comparatively new and little trodden. I can only hope that our journey has been not without some interest and some profit to you. To me the opportunity to present before such a body as the Massachusetts Medical Society the results of these investigations is one which I highly appreciate.

I desire in closing to pay my tribute of respect and to call to your grateful remembrance the founder of this lectureship, Dr. George Cheyne Shattuck. That the subject of this address would not have been without interest to him may be inferred from the title of his first Boylston Prize dissertation on the theme propounded in 1806 and entitled: "The difference between mortification produced by an external cause and that which is produced by a constitutional defect, the diagnostics and proper mode of treatment of each."¹²⁵ By his noble character, professional services and liberality Dr. Shattuck deserved well of the medical profession of his city and state, and, indeed, of the whole country, and his memory is worthily perpetuated not only by the foundation of this lectureship but also by the endowment of the chair of morbid anatomy in the Harvard Medical School.

¹²² Bulletin of the Johns Hopkins Hospital, 1899, X, p. 66.

¹²³ Op. cit.

¹²⁴ Bulletin of the Johns Hopkins Hospital, 1899, X, p. 62.

¹²⁵ Published in Boston in 1808.

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ON THE HISTOLOGY OF THE ISLANDS OF LANGERHANS OF THE PANCREAS.

BY EUGENE L. OPIE, M. D.,

Instructor in Pathology, Johns Hopkins University.

The pancreas is much more complex in structure than the other glandular organs which it closely resembles. Langerhans,¹ in an inaugural dissertation published in 1869, gave the first careful description of its histology and showed that the organ has not the relatively simple structure of the salivary glands.

Langerhans studied the pancreas of rabbits which in its essential features does not differ from that of other mammals. The larger ducts are lined by epithelium composed of a single layer of high columnar cells. As the branches of the duct become smaller, the epithelial cells become lower, cubical, and finally flat or, as seen in section, spindle shaped, the nucleus occupying the thicker central portion. The smallest ducts end in the acini composed of high columnar characteristically glandular cells containing next the lumen numerous zymogen granules. Within almost every acinus in contact with the secreting cells Langerhans found one, two, or more cells of a different nature, and to these he gave the name centro acinar cells. They closely resemble the flat spindle-shaped cells lining the very small ducts and he thinks that the epithelium of the duct is continued over the secreting cells into the lumen of the acinus, but he admits that he is unable to determine with exactness the method by which the duct ends.

Distributed at intervals in the parenchyma are groups of cells differing markedly from those of the ordinary glandular type. Such groups are usually round and in tissue, treated two or three days with Müller's fluid, appear with low magnification, as intensely yellow specks. With high magnification they are found to be composed of small, irregularly polygonal cells with a round nucleus and a refractive homogeneous cell body. Of the nature of these cell groups Langerhans declares himself entirely ignorant.

Numerous observers have described these structures which are usually designated islands of Langerhans. Renault,² regarding them as analogous to lymph follicles, speaks of them as "points folliculaires." Podwyssotski³ calls them pseudofollicles. They have been designated secondary cell groups, inter-alveolar cell islets, etc.

In injected specimens Kühne and Lea⁴ found scattered throughout the organ glomerular structures composed of dilated

and tortuous capillaries and showed that these glomeruli correspond to the cell groups which Langerhans described. The islands are penetrated by numerous wide tortuous capillaries which lie between cells forming irregular anastomosing columns. Material injected into the duct of the gland does not penetrate the islands.

Interacinar cell islets have been studied by Harris and Gow,⁵ and recently by Diamare,⁶ in a great variety of animal species, including mammals, birds, amphibia and reptiles.

Laguesse⁷ has studied the development of these bodies in sheep embryos and has reached conclusions which have not, I believe, been confirmed. He finds that at an early period of growth the pancreas is composed of tortuous tubules formed by a single layer of epithelial cells. Here and there occur cells which stain more deeply than those about them and, like the border cells of the stomach, are situated near the outer surface of the tubule. These cells proliferate and form what he calls primary islands of Langerhans. Accepting the observations of Lewaschew, to be mentioned later, he thinks that after development of the organ is completed similar structures, secondary islands of Langerhans, are formed from groups of secreting acini.

Various opinions are held concerning the nature of the interacinar cell groups. The suggestions which have been advanced may be classified as follows: (1) The islands of Langerhans, having the same origin as the secreting elements of the gland, are formed during embryological life and persisting thereafter probably subserve some special function. (2) They represent a stage in the embryological development of the gland acini and those found in the adult organ are persistent rudimentary structures. (3) They are follicles of lymphatic tissue scattered through the organ. (4) They are modified acini, transformed as the result of functional activity of a peculiar nature.

When throughout the gland structures are found composed of cells differing from those of the acini, having a different arrangement and bearing a peculiar relation to the blood-vessels, it seems probable that, formed in embryological life, they possess an anatomical identity as definite as that of the glomeruli of the kidneys or the Malpighian bodies of the

¹ Langerhans. Beiträge zur mikroskopischen Anatomie der Pankreasdrüse. Inaug.-Diss., Berlin, 1869.

² Renault. Sur les organes lymphoglandulaires et la pancreas des vertebres. Compt. rend. d. l'Acad. d. Sciences, LXXXIX, 247, 1879.

³ Podwyssotski. Beiträge zur Kenntniss des feineren Baues der Bauchspeicheldrüse. Arch. f. mikrosk. Anat., XXI, 765, 1882.

⁴ Kühne and Lea. Beobachtungen über die Absonderung des Pankreas. Untersuch. a. d. Physiolog. Instit. d. Univ. Heidelberg, 488, 1882.

⁵ Harris and Gow. Note upon One or Two Points in the Comparative Histology of the Pancreas. Jour. of Phys., XV, 349, 1894.

⁶ Diamare. Studii comparativi sulle isole di Langerhans del pancreas. Internat. Monatsschr. f. Anat. u. Phys., XVI, 155, 177, 1899.

⁷ Laguesse. Sur les principaux stades du développement histogénique du pancréas. Verhandlungen der anat. Gesellsch., 1897, 43.

spleen. Schäfer⁸ thinks that they are similar to the small ductless structures, the carotid and coceygeal glands and the parathyroid bodies which are like them composed of anastomosing columns of epithelial-like cells, between which is a network of delicate tortuous capillaries.

Laguesse⁹ has suggested that these structures represent a stage in the development of the glandular acini but has subsequently abandoned this view, in support of which there is no evidence. A number of observers have emphasized the supposed resemblance of the interacinar islets to lymphoid tissue. Renaut¹⁰ has described the pancreas as a lympho-glandular organ composed, he conceives, of glandular structures and lymphoid tissue in intimate relation. He describes the cell groups as "points folliculaires," in which cells of a glandular type are situated in the meshes a reticular tissue. Mouret¹¹ has supported Renaut's somewhat ill-defined conception of a lympho-glandular organ, but has regarded the cell group as small masses of lymphoid tissue. Kühne and Lea and Dieckhoff¹² think it probable that they are small lymph follicles. Schlesinger¹³ regards them as a variety of lymph follicle whose cells differ from those of ordinary lymphoid tissue. Podwysotski calls them pseudo-follicles and states that though they resemble lymph follicles their cells have nothing in common with lymphoid cells.

The only attempt to investigate experimentally the nature of the islands of Langerhans has been made by Lewaschew,¹⁴ working in Heidenhain's laboratory. He studied the pancreas of dogs and cats, killed after having been subjected to conditions which cause the gland to secrete actively. After prolonged overfeeding or after the administration of pilocarpin, which stimulates the pancreas as it does the salivary glands, he claims to have found structures representing transitions between the gland acini and the interacinar cell group. He observes acini containing one or more cells whose protoplasm is non-granular and stains lightly. A whole acinus or a number of acini may be composed of such cells. In such areas some of the cells may assume a polygonal shape and are no longer grouped to form a central lumen. Other cell groups consist entirely of polygonal cells without acinar arrangement, and these represent, he thinks, the fully formed islands of Langerhans.

In order to obtain a large increase in the number of altered acini one even maximal stimulation of the gland is not suffi-

cient, but by the repeated administration of pilocarpin the result is accomplished and the longer and more intense the action of the drug the greater their number. To cause their increase by overfeeding a very large quantity of food is necessary. Lewaschew believes that the cells composing the interacinar groups may reassume the characters of secreting cells and again form acini. He mentions that he has found an unusual number of islands under conditions other than those of increased functional activity. They were very numerous in a dog which several days before its death had suffered with fever.

The observations of Lewaschew have not been confirmed. In the human pancreas one occasionally finds altered glandular cells. Non-granular refractive cells may occur in otherwise normal acini and entire acini or groups of acini may be composed of such cells. Laguesse,¹⁵ regarding them as transitions between acini and interacinar groups, has adopted the view of Lewaschew.

It is by no means surprising that little is known concerning the function of structures whose nature is so little understood. Laguesse¹⁶ thinks that they represent secreting acini temporarily modified to adapt themselves to a new function, the elaboration of an internal secretion. Schäfer¹⁷ and Diamant think that the vascular islets probably furnish an internal secretion. The only evidence in support of this suggestion is contained in the short preliminary notice of Ssobolew.¹⁸ He states that after feeding animals on carbohydrates the cells of the islands become more granular. After ligating the duct of Wirsung in dogs the islands of Langerhans, he finds, are not involved in the sclerotic process which follows. He thinks that this fact explains the absence of glycosuria after ligation of the pancreatic ducts. In human cases I had observed after duct obstruction¹⁹ similar resistance of the island to the consequent inflammation. In pancreas of two diabetic Ssobolew was unable to discover islands of Langerhans.

I have attempted to determine the relation of the islands of Langerhans to the other elements of the pancreas. They have been observed in human cases under a great variety of conditions, in cats and in dogs. Their relation to the blood vessels has been studied in injected specimens. Finally, I have attempted to repeat the experiments of Lewaschew in order to test the possibility of transforming acini into interacinar cell islets.

In the human pancreas the islands were found to be more numerous in the splenic end or tail than elsewhere. To obtain a numerical statement of their relative abundance, their num-

⁸ Schäfer. Quain's Anatomy, Vol. III, Pt. IV, p. 318.

⁹ Laguesse. Sur la formation des îlots de Langerhans dans le pancréas. Compt. rend. Soc. de biol., 9. S., V. 819, 1893.

¹⁰ Renaut. Loc. cit.

¹¹ Mouret. Tissue lymphoïde du pancréas et cellule centro-acineuse. Compt. rend. Soc. de biol., 10. S. I., 731, 1894.

¹² Dieckhoff. Beiträge zur pathologischen Anatomie des Pankreas. Festschrift f. Thierfelder, Leipzig, 1895.

¹³ Schlesinger. Die Erkrankung des Pankreas bei hereditärer Lues. Virch. Arch., CLIV, 501, 1898.

¹⁴ Lewaschew. Ueber eine eigenthümliche Veränderung der Pankreaszellen warmblütiger Thiere bei starker Absonderungsthätigkeit der Drüse. Arch. f. mikros. Anat., XXIV, 452, 1886.

¹⁵ Laguesse. Sur quelques détails de structure du pancréas humain. Compt. rend. Soc. de biol. S. 10., I, 667, 1894.

¹⁶ Laguesse. Compt. rend. Soc. de biol., 9. S., V, 819, 1893.

¹⁷ Schäfer. Internal Secretions. Lancet, 1895, II, 321.

¹⁸ Ssobolew. Ueber die Structure der Bauchspeicheldrüse unter gewissen pathologischen Bedingungen. Centralbl. f. allg. Path. u. path. Anat., XI, 202, 1900.

¹⁹ Opie. Pathological Changes Affecting the Islands of Langerhans of the Pancreas. Jour. Boston Soc. Med. Sciences, IV, 25, 1900.

ber was determined in a sectional area of 0.5 square centimetre. Sections about 10 μ thick were made from the enlarged duodenal portion of the pancreas or the head, from the mid-portion or body and from the splenic end or tail. The following table gives their number in an area of 0.5 square centimetre in sections taken from the head, body and tail of ten normal organs:

TABLE I.

	Head.	Body.	Tail.
I.....	11	13	30
II.....	30	25	42
III.....	4	4	19
IV.....	4	10	13
V.....	27	18	59
VI.....	25	27	26
VII.....	18	18	29
VIII.....	6	10	29
IX.....	44	32	61
X.....	14	23	32
Average....	18.3	18.0	34.0

The table shows that the islands are more abundant in the tail or splenic end than in the head and in the body, where they are present in approximately equal number. They are almost twice as numerous in sections from the tail as in those from other parts. Since the number in only one plane is recorded, in order to obtain their actual relative abundance it is necessary to square these figures. They are then found to be slightly less than three and a half times as numerous in the tail as elsewhere.

The islands of Langerhans are more numerous, as pointed out by Kasahara,²⁰ in the pancreatic tissue of the foetus and of very young children than in that of the adult. Should we assume that they are formed during embryological development and persist thereafter, this fact is readily explicable. The organ being much smaller in the foetus and in the young child, the same number of islands, though themselves smaller, are closer together and therefore appear to be more numerous in sections.

The cells composing the islands resemble those of the acini. They have a large round, occasionally oval, vesicular nucleus and a conspicuous cell body. The basal zone of the secreting cell, as is well known, stains deeply with nuclear dyes, for example, hæmatoxylin or methylene-blue, while the central portion which contains zymogen granules remains unstained. The cells of the island, however, do not stain with nuclear dyes, while with eosin their protoplasm takes a homogeneous bright pink color. The nuclei differ but little from those of neighboring acini. They vary considerably in size and not infrequently one finds very large round vesicular nuclei whose diameter is two or more times that of those about. Occasionally the cells, forming columns between which are the anastomosing capillaries, are very closely packed together and

nuclei are situated almost side by side; more frequently the cells of the island are less numerous and the nuclei are less closely crowded together.

The outline of the island is usually round or oval and is not infrequently accentuated by a delicate circle of fibrous tissue. In other instances the outline is less sharp and the body accommodates its shape to that of the neighboring acini. Occasionally one sees, apparently within the island, cells arranged, as in the acini, about a central lumen and, indeed, in many instances it is difficult to convince one's self that they do not form part of it. The impression is produced that the columns of the island are in continuity with cells having an acinar arrangement. Since the islands and the secreting acini have a common origin it is not inconceivable that they may occasionally remain continuous in the adult organ. When the foetal pancreas is affected by congenital syphilis, the islands, I have found,²¹ retain their continuity with the secreting structures.

In the human pancreas the groups of acini about terminal ducts are not sharply defined by connective tissue, so that individual lobules, as in the human liver, are indistinctly marked off and in places apparently fuse with one another. In the pancreas of the cat the lobules, like those in the liver of the pig, are much more sharply outlined by interstitial tissue. Details of structure have been studied in the pancreas of the cat.

The parenchyma is divided by septa of fibrous tissue into small polygonal areas varying in size and shape. When injected with Berlin-blue a small ramification of the ducts is found to penetrate the isolated group of acini. These subdivisions or lobules often appear completely isolated by fibrous tissue from those nearby, but when one of them is traced through a series of sections its separation may not be uniform and in places one finds the parenchyma of adjacent lobules in contact, the dividing septa being incomplete. That these polygonal structures are actually independent of one another and represent units of structure is readily demonstrated by causing an inflammatory increase of the interstitial tissue. If the pancreatic ducts of a cat are ligated and the animal killed at the end of two or three weeks, the gland is found to be the seat of a chronic interstitial inflammation, characterized by an increase of the interlobular tissue. The lobules are completely separated from one another by narrow bands of firm fibrous tissue and occur in sections as rounded triangular or polygonal areas of parenchyma.

The islands of Langerhans occupy a position near the centre of the lobule and in the splenic end of the gland each lobule contains an island. In a given section many lobules whose limits are more or less distinctly outlined are seen to contain islands situated near their centre, while in neighboring lobules such structures may not be discoverable. If, however, serial sections are studied every lobule is found to contain an island. Its presence within the lobule is not constant in other parts of the organ, and in the extremity

²⁰ Kasahara. Ueber das Bindegewebe des Pankreas bei verschiedenen Krankheiten. Virch. Arch., CXLIII, 111, 1896.

²¹ Ople. Loc. cit.

of the descending arm of the gland they are very few in number.

The lobules are grouped about the medium sized ducts. The main ducts give off branches approximately at right angles to their course. Branching one or more times a duct forms the centre of a group of lobules, which is usually elongated in form and tapers to a point at or near the surface of the gland. Such lobule groups are separated from one another by relatively wide bands of areolar tissue much looser in texture than that separating the individual lobules. The lobule groups in the fresh state or in tissue macerated a few



Fig. 1

FIGURE 1.—Camera lucida tracing of the lobule boundaries in one of a series of sections from the splenic end of a cat's pancreas. The majority of the lobules are well defined. Those marked *d*, *e*, *f*, *g* and *h* are poorly outlined but are found to be more readily distinguishable when traced through the series of sections. The lobules, which are lettered (*a* to *o*), were traced through the series and each was found to contain an island of Langerhans situated near its centre. The section passes through the island in lobules *a*, *c*, *i*, *j* and *n*.

days in Müller's fluid may be separated from one another by careful teasing. In the loose tissue lie the larger ducts, arteries, veins, and nerves. An artery and vein penetrate each lobule group in company with the duct and ramify between its lobules. The smallest arteries occasionally penetrate the lobules, but usually branches, diminishing in size, give off capillaries which enter the lobule and form a close network between the gland acini.

The capillaries of the island of Langerhans form a glomerulus of tortuous freely anastomosing vessels, much thicker than those between the acini. A single afferent vessel like that of the glomerulus of the kidney does not enter this group

of dilated capillaries but numerous anastomoses make it continuous with the interacinar capillaries. When Berlin-blue is injected through the aorta into the arteries of the pancreas it not infrequently happens that in portions of the gland which are poorly injected the vessels of the island are filled with the injected mass, while the surrounding capillaries are for the most part empty. If instead of soluble Berlin-blue a granular injection mass, for example, cinnabar or ultramarine blue is used, the islands may be injected while the interacinar capillaries contain little of the injected material. The glomerular network is in very free communication with the smallest arteries and apparently has a richer blood supply than other parts of the lobule.

In the human pancreas lobules and lobule groups are not so regularly arranged as in the cat. But both structures are more or less clearly definable. The lobules vary much in size and are usually not clearly separated from one another. Though an island of Langerhans is often situated in the centre of a more or less clearly defined lobule, no constancy of position is discoverable. The lobule groups are separated by relatively wide bands of loose areolar tissue in which are contained the medium sized ducts, the blood-vessels and the nerves. Within the lobule group the arteries and veins which are side by side do not, as in the cat, accompany the ducts.

In the normal human pancreas one occasionally finds small groups of acini composed of cells differing from the typical glandular type and suggesting a transition from the secretory cell to that of the island of Langerhans. The cell-protoplasm does not take the nuclear dye as does the basal portion of the ordinary glandular cell, and when stained with eosin has a bright pink color and homogeneous refractive appearance. The nucleus, which shows no evidence of degenerative change, is situated near the centre of the cell. Occasionally one or more cells of the character described form part of an acinus, which otherwise resembles those about it. Usually, however, a group of acini are changed, and such an area often corresponds in size to an island of Langerhans.

The presence of altered acini whose cells resemble those of the island confirms at first sight the view of Lewaschew that groups of acini may assume the characters of the interacinar structures. It is probable that such foci in part at least represent what Laguesse²² and Pischinger²³ have described as stages of transition. The arrangement of more or less columnar cells about a central lumen is, however, still preserved and one does not find similar areas in which this arrangement is lost. The lumen, indeed, is usually very conspicuous and is often considerably dilated, filled with products of secretion which stain deeply with eosin. It seems probable that these groups of acini are altered as the result of peculiar functional activity, it may be, of hyperstimulation of the gland. There is at least no evidence that they represent

²² Laguesse. *Compt. rend.*, S. 10, I, 667, 1894.

²³ Pischinger. *Beiträge zur Kenntniss des Pankreas. Iraag. Diss.*, München, 1895.

transitional stages between gland acini and islands of Langerhans.

Such altered acini are observed in a small proportion of normal glands. They were found in three of twenty-seven glands examined carefully for their presence. They were present in three of seven relatively normal organs from diabetic patients. The occurrence of voracious appetite and increased food ingestion in individuals so affected may explain the occurrence of these areas which represent possibly foci of peculiar secretory activity. They were particularly abundant in one instance of chronic interstitial pancreatitis not associated with diabetes.

Lewaschew has claimed that he was able to transform groups of secreting acini into islands of Langerhans by stimulating the pancreas with pilocarpin. A single administration of the drug does not suffice, but by its repeated administration an undoubted increase in the number of islands may, he says, be obtained. Under such conditions these bodies appeared to be more numerous than usual, but he has made no attempt to determine their actual number. He does not record the amount of pilocarpin used nor the frequency of its administration. His experiments have not been repeated.

I have attempted to confirm the observations of Lewaschew by injecting subcutaneously pilocarpin muriate into dogs. Since the number of islands was found to vary in different parts of the gland, it was considered desirable to study sections from corresponding parts of the organ. Specimens were prepared from (a) the splenic extremity, from (b) the portion which is in contact with the duodenum, and from (c) the descending portion which lies in the mesentery of the duodenum. In order to determine with accuracy the relative abundance of the islands their number was counted in a measured sectional area and compared with that found in the pancreas of an animal to which pilocarpin had not been given. Following is a summary of the experiments performed:

Dog No. 1.—The animal was given daily for nine successive days 0.02 to 0.03 grm. of pilocarpin muriate. Profuse salivation was produced often with vomiting and diarrhoea.

Dog No. 2.—During twenty-eight hours pilocarpin muriate

0.005 to 0.01 grm. was injected subcutaneously six times. The drug produced profuse flow of saliva.

Dog No. 3.—During twenty-four hours pilocarpin muriate 0.01 grm. was injected subcutaneously seven times. Profuse salivation followed each injection.

In the table the figures represent the number of islands in 0.5 square centimetre of sectional area. The letters refer to the parts of the gland indicated above.

TABLE II.

Injected animal.	a.	b.	c.	Control animal.	a.	b.	c.
Dog No. 1...	61	21	1	Dog No. I...	59	61	14
No. 2...	55	20	11	No. II...	39	53	3
No. 3...	54	72	8	No. III...	67	89	12
Average	56.6	37.6	6.6	Average	55.	67.6	9.6

The figures show that no increase of the number of islands was obtained in the three experiments. Transitional stages between glandular acini and interacinar islets were not observed. The number of islands in that part of the descending portion of the pancreas which lies in the mesentery of the duodenum (c) is constantly much less than elsewhere. The number in different glands and in different parts of the same gland varies considerably. In the experiments of Lewaschew these sources of error have apparently not been given sufficient weight.

CONCLUSIONS.

(1) The islands of Langerhans are composed of cells having the same origin as those of the glandular acini but forming structures which are independent of the secreting apparatus and in intimate relation with the vascular system.

(2) In the splenic end of the cat's pancreas they have a definite position within the lobule, each of which contains one of these structures.

(3) In the human pancreas they are more numerous in the splenic extremity or tail than elsewhere. Similar variation in their number is observed in cats and dogs.

(4) Prolonged stimulation of the gland does not, as claimed by Lewaschew, transform groups of acini into islands of Langerhans.

THE DISTRIBUTION OF CONNECTIVE TISSUE IN NEW GROWTHS.

BY W. C. WHITE, M. B.

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

I here report the result of the study of the distribution of connective tissues (viz., yellow elastic tissue, white fibrous tissue and reticulum) in seventeen new growths, obtained in fresh state from the Surgical and Gynecological Department of the Johns Hopkins Hospital through the kindness of Dr. Cushing and Dr. Kelly.

The work was done in the Pathological Laboratory of the Hospital at the suggestion of Dr. L. F. Barker, and I am

much indebted to him for his willing and valued assistance throughout. To Dr. F. P. Mall I am also under obligations for many kind suggestions.

The following methods were employed:

1. For the study of elastic tissue.

(a) Demidessication and artificial oedema; fresh tissue stained with magenta.

(b) Weigert's¹ elastic fibre staining of the hardened tissue.

(c) Unna's orcein stain (hardened tissue).

2. For the study of white fibrous tissue and reticulum.

(a) Mall's method.² Digesting the fresh frozen section in pancreatin solution.

(b) Spalteholtz' method.³ Digesting sections of hardened tissues in pancreatin solution, alternate sections being stained with hæmatoxylin and eosin for comparison.

(c) Van Gieson's picric acid fuchsin stain.

(d) Mallory's new connective tissue stain, the use of which was very kindly permitted by Dr. Mallory, although the formula is still unpublished.

In studying the distribution of these tissues it has been taken for granted (1) that the tissue staining purplish with magenta in the fresh preparations and deep blue with Weigert's stain in the hardened preparation is elastic tissue, and (2) that the tissue left after digestion in pancreatin solution and staining red with Van Gieson's stain and blue with Mallory's stain is either white fibrous tissue or reticulum, and I have called them such in writing this paper.

The object has been, not to study the distribution of one kind of connective tissue, but to study the character and distribution of the several kinds by many methods.

It has been a great drawback that there is as yet no certain method of distinguishing white fibrous tissue and reticulum. Siegfried⁴ has found in reticulum a substance which he calls reticulin, thus distinguishing it from white fibrous tissue which yields gelatine, but this method was not practically applicable in the present study. Then certain structural differences, it is asserted, exist between the two substances; viz., the wavy more or less parallel fibrils of white fibrous tissue running in bundles as against the very fine anastomosing and branching fibrils of reticulum; but the two substances are so intimately associated in any structure that the question arises of the possibility of the one being the final breaking up and division of the other.

In the sarcomata and myomata reticular networks were found which in structure coincided with reticulum, the fibrils definitely branching and anastomosing, but they were here intimately associated with bundles of wavy parallel fibres which were just as typical of white fibrous tissue. In some places this reticular network appeared to have its origin from these bundles, while in other cases it seemed only to gain an anchorage there, the fibrils extending only for a short distance among the fibres of the bundles. In other places, and this was very frequent in the sarcoma sections studied by Mall's method, the fibrils of the reticular network appeared to arise from certain focal points suggesting the possibility of their being the processes of cells which had been digested away, but the most probable explanation of this appearance was to

be found in the thickness of the sections, several fibrils overlapping one another at certain points. Again, the fibrils which presented the structural characters of white fibrous tissue were frequently seen in the Mall preparations to break up into much finer fibrils, suggesting the possibility of the two substances, white fibrous tissue and reticulum, being the same substance, the latter being the final division of the former.

So that without some method of determining the distinction or relation between the two substances the description of what was found in the present study has necessarily been purely objective, the two substances being included under the one head. Still some endeavor was made to discover the relation after pancreatin digestion of what was found in myomata to tendon and also to reticulum by the following method suggested by Dr. Mall.

Tendon was obtained from the human tendo-achillis. Reticulum was obtained from the gut of a dog by drawing the small intestine between the handles of a pair of scissors and thus removing the muscular coats and mucous membrane leaving only the submucosa. A myoma was secured after removal from the human uterus. Small sections of all three were cut and digested in pancreatin solution.⁵

They were then thoroughly washed in water and later placed in test tubes containing (1) $\frac{1}{2}$ per cent hydrochloric acid; (2) 1 per cent hydrochloric acid; (3) 1 per cent solution of caustic potash and immersed in a beaker of boiling water and the results tabulated.

I have given also by permission the tables of Dr. Mall⁶ and of Dr. Flint.⁷

TABLES.

DR. MALL'S TABLE.

	Time taken to dissolve tendon.	Time taken to dissolve reticulum.
Boiling KOH 1%	30 seconds.	1.5 minutes.
Boiling HCl $\frac{1}{2}$ %	1 minute.	18 minutes.
Tissues remaining in the solution one hour before boiling.		

DR. FLINT'S TABLE.

Solution.	Time required to dissolve.		
	Tendon.	Adrenal reticulum.	Lymph gland reticulum.
HCl 0.5%	3 $\frac{1}{4}$ mins.	10 mins.	11 $\frac{1}{2}$ mins.
KOH 0.13%	3 mins.	14 $\frac{3}{4}$ mins.	22 mins.

In Dr. Flint's work the sections remained in the solutions two hours before boiling, and at the end of the time given the tendon was completely dissolved and the solutions clear, while the reticulum in each case remained as a granular detritus even after boiling for thirty minutes.

Solution.	Time required to dissolve		
	Tendon.	Reticulum.	Myoma.
Boiling HCl .5%	27 mins.	43 mins.	55 mins.
" HCl 1%	12 mins.	22 mins.	27 mins.
" KOH 1%	27 mins.	29 mins.	30 mins.

At the end of the different times given the tendon in each

¹ Centralbl. f. alg. Path. u. path. Anat. IX, 1899.

² Johns Hopkins Hospital Reports, Vol. I, 1896.

³ Archiv f. Anat. u. Phys., Anat. Abth., 1897, Supp. Bd.

⁴ Habilitationsschrift, Leipzig, 1892.

⁵ Pancreatin (P. D. & Co.), 5 grm.; sodium bicarbonate, 10 grm. water, 100 cc.

⁶ Loc. cit.

⁷ The Blood Vessels of the Adrenal. Contributions to the Science of Medicine. Dedicated to Wm. H. Welch, Baltimore, 1900.

se was completely dissolved and the fluid remained quite clear, but in the case of both the reticulum and the myoma here remained a minute granular detritus in a very cloudy or turbid fluid. The appearance of tendon was also quite different both from the myoma and the reticulum, which two latter substances behaved very similarly. The edges of the tendon section within a few minutes became very much swollen and assumed a gelatinous or translucent appearance, and this gelatinous area increased at the expense of an opaque centre, but at the same time dissolved away until all had passed into solution. The myoma and reticulum, on the other hand, became shreddy and granular in appearance and gradually broke up into very minute granules which remained suspended in the fluid. In the myoma in the 1 per cent hydrochloric acid solution it was noticed at the end of four minutes that there appeared some swelling and translucency spots on the surface, but this had all disappeared at the end of ten minutes and after this it behaved very similarly to reticulum. A longer time was taken to accomplish the solution than in the other two tables, but this was probably due to the larger sections used. In the latter cases frozen sections were used, while in this work the pieces measured probably 1 cm. square. In the caustic potash experiment the section of tendon was somewhat larger than the other two sections.

Also based upon Mall's⁸ finding that tendon is much more quickly dissolved in pepsin solution than either reticulum or elastic tissue, several frozen sections of myoma were digested for twenty-four hours in pancreatin solution, then washed in water and subsequently put in pepsin solution in a thermostat and removed at different times, 5, 10, 15 and 30 minutes. Mall found that tendon was completely dissolved in a strong solution of P. D. & Co.'s pepsin in from 10 to 30 minutes, while elastic tissue and reticulum only begin to be dissolved at the end of this time. In these sections all evidence of structure was lost, even at the end of five minutes, but at the end of thirty minutes a considerable portion, possibly amounting to one-third of the original section was removed upon the slide. This experiment, however, loses much in value from the fact that no control specimens of either tendon or reticulum were made.

Regarding the two methods of studying white fibrous tissue—1. reticulum by digestion, viz., that of Mall and that of Spalteholtz, each one gives evidence of value that is not obtained from the other, and as Flint says, both should be used together since in Mall's method owing to the thickness of the section a suggestion of a third dimension is obtained and the fibrils may be traced in most cases throughout their entire course. On the other hand, of the relation of the connective tissue to the cells of the growth very little can be decided owing both to the spreading of the section in mounting and to the difficulty in obtaining a near control section. In Spalteholtz' method, however, since alternate sections are easily obtained, one being digested and the other stained

intact, the relation of cells and connective tissue is readily studied, but owing to the thinness of the section the fibrils are cut short and in many cases appear only as minute spirillar forms, it not being possible to follow their course for any distance.

The subject of elastic tissue in new growths has received a number of contributions since the publication of Weigert's elastic fibre stain.

Melnikow Raswedenkow in Ziegler's Beiträge, Bd. 26, 1899, has described the distribution of elastic tissue in various organs in normal and pathological conditions, and states that elastic fibres in healthy and diseased tissues are derived mainly from the vascular walls, and further that in tumors no new formation of elastic tissue occurs. In the discussion on the paper, however, in the German Pathological Society in Munich,⁹ a number of observers reported cases where an increase in amount was present. Hansemann reported a large increase of elastin in a case of metastatic tumor in the spleen but had not found any, as a rule, in malignant growths. Schmorl reported a case where numerous elastic fibres were found in a carcinoma of the stomach. Orth and Naubereck found in carcinomata cases very many elastic fibres present.

Alice Hamilton¹⁰ has reported a case of fibro-sarcoma of the brain in which there was a very large amount of elastic tissue present; the tumor presented a very peculiar rosette arrangement and in places masses of considerable size surrounding blood-vessels, all of which masses were of a fibrillar nature, but elastic tissue was also present as wavy fibrils running among the cells without any apparent relation to a vessel wall or to the cells of the growth. She agrees with Melnikow Raswedenkow as to the origin of elastic fibres from vessel walls but contradicts his statement that in tumors no new formation of elastic tissue occurs. In this case the amount was much more than normal, but the relation was frequently to the periphery of the vessel wall, and where this relation was not found, the presence of elastic tissue was ascribed to the obliteration of the vessel or to the severance of the original connection of the fibres.

H. W. Williams,¹¹ in a paper on the new formation of elastic fibres, gives a report of his study of 37 cases of carcinoma; 12 in the liver, 4 in lymph nodes, 2 in the thoracic duct, 2 in large veins, 2 in the cerebrum, 1 in the lung, 8 in the mammae, 1 in the skin, 4 in the stomach and 1 in the rectum. The following are his conclusions:

1. When the stroma of a carcinoma is itself of new formation it is usually free from elastic fibres.
2. Newly formed elastic fibres may occur in the stroma, though rarely, and they are likely to be fine in quality and small in number.
3. The tumors in which newly-formed elastic fibres occurred either contained a large amount of connective-tissue

⁹ Centralbl. f. alg. Path. u. path. Anat., X, 832.

¹⁰ Jour. of Exp. Med., Vol. IV, Nos. 5 and 6, 1899.

¹¹ Contributions to the Science of Medicine. Dedicated to Wm. H. Welch. Baltimore, 1900.

stroma or the newly-formed fibres were in connection with pre-existing elastic elements of the original parts.

He found evidence of new formation in three cases of carcinoma of the liver. In carcinomata of lymph nodes the stroma was usually free from elastic tissue and when present it was not possible to demonstrate its new formation. In one carcinoma of the thoracic duct there was new formation and in two of the venous growths. In two of the cerebral cases, one secondary from an adeno-carcinoma of the lung and one secondary from the stomach, there were fine elastic fibres present possibly connected with some prolongation of the pia mater. In the carcinomata of the mamma nothing was seen to prove new formation.

Kromayer¹² found in rapidly-growing condylomata, warts and carcinomata of the skin no newly-formed elastic fibres. These were present, however, in older papillomata and fibromata.

There are also a considerable number of papers on the new formation of elastic tissue in other pathological conditions, to which reference will be found in Dr. Williams' paper.¹³

In seven of the seventeen cases in the series here reported, elastic fibres were found, the description of which will be found under the individual cases. In all cases they apparently had their origin from the vessel walls. In only one case, No. 6, a carcinoma of the breast does there seem to be sufficient ground for claiming an increase in amount or a new formation. The sections from this case were compared with those from three normal breasts and three other carcinomata and contained a much greater amount of elastic tissue than any of the others.

The safest method of judging the amount of new formation if such exists in any case would seem to be that of comparison of sections of the growth with sections of the normal tissue in which the growth was situated. This, unfortunately, was only done in one case (case 18). In this case a portion of the normal breast in which the carcinoma had grown was prepared in the same way as the growth itself. A description of the comparison will be found under this case.

Regarding the origin and normal development of elastic fibres whether from the transformation of cells, by fusion, into fibres or from the transformation of the intercellular matrix there is still no satisfactory answer.

On the subject of the study of tumors by digestion methods no literature was to be found.

DESCRIPTION OF INDIVIDUAL CASES.

Specimens Nos. 1, 4 and 8. Fibromyomata of the uterus.

Elastic Tissue.—In these cases there were no elastic fibres found either in the fresh preparations or in the hardened sections stained with Weigert's elastic fibre stain.

White Fibrous Tissue and Reticulum.—To the naked eye these sections gave the appearance of a fibrillary structure and under the dissecting microscope the fibrillary nature was more clearly seen. The tissue remaining after digestion was collected in places in thick masses and strands, from both of which branches were given off and these again branched in turn. The thicker strands presented in places a distinctly whorled appearance, and between the masses and strands minute wavy fibrils were seen running in a more or less parallel direction and passing into and becoming continuous either end with the thicker portions of the section.

Under the low power of the microscope the masses formed nodal points from which prolongations were given off, an infinite number of very fine fibrils appearing in places.

The larger strands were composed of minute fibres in very close apposition to one another. These strands divided and reunited again and gave off branches, and from these branches



FIG. 1.—Section of a fibromyoma digested by Spalteholz' method showing the bundles of white fibrous tissue and the reticular network in the meshes of which the muscle cells lay.

and from the sides of the strands themselves there arose exceedingly minute, very wavy, interlacing fibrils running in a course more or less parallel to one another, and in some places arising from one strand and passing into and becoming continuous in another strand.

In other parts of the section between the strands was seen a very fine network similar to that obtained by Spalteholz' method to be described later.

With the high power the fibrillary nature was more clearly seen in some parts, the fibrils being very wavy, in others quite straight throughout their course. The strands themselves were composed of the wavy interlacing fibres of white fibrous tissue while the minute network presented very much the appearance of a fine, delicate mesh.

¹² Monatsschrift f. prakt. Dermatologie, Bd. XIX.

¹³ Loc. cit.

pearance of reticulum except that in these sections no definite anastomosis was observed.

In the preparations by Spalteholz' method very little could be made out either with the naked eye or with the dissecting microscope, but with the latter very minute apertures throughout the section were plainly seen.

Under the low power, however, the condition described under the Van Gieson and Mallory preparations is very clearly seen; viz., a connective-tissue envelope for each muscle-cell. The connective tissue was very abundant and formed by far the major portion of the section. It was arranged in two ways.

1. Running in every direction and forming a large irregular network, leaving meshes of varying size, were large strands composed of wavy interlacing fibres which followed a more or less parallel course. In places these strands divide and unite again, leaving spaces which are occupied by the network to be described later. In the midst of these strands are seen also the apertures of blood-vessels surrounded by denser tissue, the size of the vessel varying with the size of the strand.

2. In the meshes formed by this stroma was found a minute network apparently formed by the division, subdivision and anastomosis of the branches of this stroma proceeding from all sides of it as it surrounded the individual spaces. The minute meshes of this second network are filled in the control specimen with single muscle cells.

Van Gieson Preparation.—To the naked eye the general impression of this section was red, but on holding it up to the light areas having a yellowish tint were seen. These varied in size and were surrounded by a capsule of deep red. Besides these areas there were certain parts of the section of lighter and apparently uniform red color, intimately connected with the capsules of the yellowish areas. The capsules surrounding the yellowish areas formed an irregular network throughout the remainder of the section.

With the dissecting microscope the darker capsules mentioned above were seen to run through the section looking like an injected vascular network. The branches from this network ran into and divided the yellowish areas which they surrounded into still smaller areas.

The lighter reddish masses seen with the naked eye were not so uniform in color, but appeared as a very close network of red stained tissue, and held in the meshes of this network were yellowish cell bodies similar to those found in the other areas, but here the red stained material was much more abundant, the strands being thicker and the meshes smaller.

The general network of red stained connective tissue was regular, the meshes varying in size, the larger bundles of strands surrounding the larger yellowish areas and branches from these forming the walls of smaller areas, but even in the larger strands of red, small groups of yellowish cells were frequently seen.

With the low power the uniform reddish masses were seen to be composed of a dense network of comparatively thick strands of red with small meshes containing the yellowish

cell bodies. These yellowish cells were evidently the muscle cells and will be so called in the further description.

The general network of red could be traced with this power to much smaller divisions, in some cases the branching and anastomosing forming so small a network that the meshes of the same contained only a single muscle cell.

The larger strands of red-stained connective tissue had in places a definite whorled appearance and throughout their substance were seen scattered the connective-tissue corpuscles. In these strands were also seen numerous blood-vessels, the larger ones occurring in the larger strands and so on. The muscle cells of the walls of these vessels were stained yellow, similarly to those contained in the general network.

Under the high power the network of connective tissue could be traced to still finer divisions, so that each muscle cell was here seen to have an enveloping capsule of its own, very fine in most instances but comparatively thick in others. In the midst of the larger strands occasional muscle cells were also present.

Mallory's stain gave a very similar picture to that obtained by Van Gieson's stain.

Specimen No. 2 was from a sarcoma of the uterus, but contained so small a portion of sarcomatous tissue that it was of very little service for study; still in the Spalteholz preparation a reticular network similar to that found in other sarcomata was demonstrated in one portion of the section.

Specimen No. 3 was a portion of the wall of a multilocular ovarian cyst and showed only a dense white fibrous tissue structure in which no elastic fibres were found.

Specimen No. 5 was an epithelioma of the inferior maxilla. This growth was of five and one-half years' duration, but for one year previous to its removal had grown very rapidly. It involved the whole depth of the left half of the inferior maxilla from the ramus behind to a point 2 to 3 cm. beyond the middle line in front. It presented a lobulated appearance with a reddish surface looking like granulation tissue and had an actively growing appearance.

No elastic tissue was found by either method except around the vessels.

Mall's preparation was very unsatisfactory for study; the connective tissue remains forming a more or less solid mass, from which nothing but a fibrillary construction could be made out.

Spalteholz' method showed a distribution of connective tissue similar to that described below under Mallory's stain, the parts of the control section occupied by the large irregular masses of cells being in the digested specimen quite devoid of connective tissue.

The section stained by Mallory's stain gave in this case the best idea of the distribution of the white fibrous tissue, its absence in the cellular areas and its distribution being controlled by the Spalteholz' preparation.

The ground work of the section was made up of extensive

strands and bay-like processes of epithelial cells joined together by their minute protoplasmic processes which were very plainly visible and appeared in places as a reticular network; of this, however, nothing remained after digestion. These strands of cells formed a connected network but in certain places became condensed, lying much closer together in rows surrounding larger and smaller irregular spaces which contained a fine loose network of connective tissue, holding in its meshes numbers of connective-tissue corpuscles and polymorphonuclear cells.

The connective tissue in these spaces was collected in the centre into bundles and masses of wavy fibres, and from these minute fibrils radiated outward in all directions as an exceedingly minute fibrillary network, becoming gradually looser in texture until at the edge just inside of the rows of cells they curved and formed an interlacing ring of tissue which, however, sent no processes among the cells of the growth. This latter condition was only demonstrated by the Spalteholz' preparation.

In several of these spaces there were also seen small blood-vessels swung in the network.

Besides the connective tissue in these spaces there were several strands of white fibrous tissue fibrils which divided the section into smaller portions, but had not been invaded by epithelial cells. These strands were evidently the origin of the connective tissue in the spaces, as many of the latter were found continuous with the former. The connective tissue in the isolated spaces had apparently been shut off by the invasion of the epithelial cells and had then commenced to throw out new fibrils, for in these spaces the connective tissue corpuscles were in a very actively multiplying condition, the nuclei dividing and undergoing mitotic changes.

The larger strands carried in their substance several large blood-vessels. In one or two places in the sections areas of degeneration were present filled with granular debris and polymorphonuclear cells, and around these areas, extending for some distance among the surrounding cells, many polymorphonuclear cells were to be found.

Specimen No. 6 was part of a carcinoma of the left breast in a woman 56 years of age. The growth was of one year's duration and at the time of removal measured 5.5 x 5 cm. Besides this larger nodule there was a second smaller growth 4.5 x 1.7 cm. in size. The nipple was slightly retracted and there were metastases in the cervical and axillary glands.

Elastic Tissue.—The fresh tissue teased out upon a slide and stained with magenta showed a considerable number of purple stained elastic fibres varying in thickness, quite wavy and curled at their free ends.

The frozen section stained with magenta also showed elastic fibres around groups of cells, around the blood-vessels and lymphatic ducts and also throughout the connective-tissue stroma.

In the preparation hardened in Zenker's solution and stained with Weigert's elastic fibre stain, the sections presented, even to the naked eye, many blue-stained areas, repre-

sented the elastic tissue. This was distributed throughout the section in two ways: (1) Surrounding certain definite areas and marking these off distinctly from the rest of the section. (2) As minute lines running for short distances through the balance of the section.

Under the low power the areas mentioned above were composed of the cells of the growth grouped together in varying numbers from 5 or 6 up to many hundreds, and immediately outside of these groups was an irregular or serrated encasement of elastic tissue in single and double layers, and outside of this again a layer of connective tissue in which were scattered many minute fibrils of elastic tissue. These were evidently the lactiferous tubules which had been invaded by the growth. Many elastic fibres were also present in the walls of the blood-vessels. There were also a number of very small areas containing only three or four cells which were com-

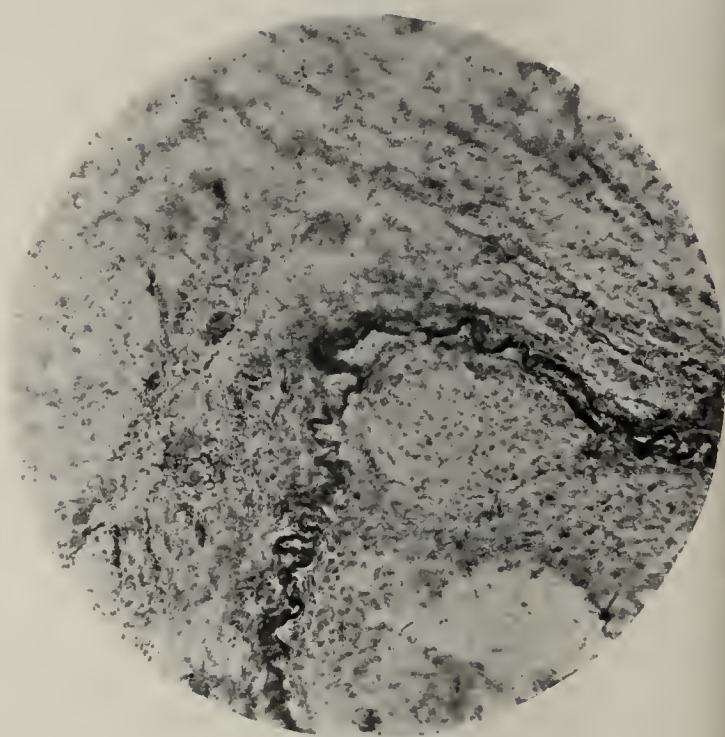


FIG. 2.—Section of carcinoma of breast No. 6, stained Weigert's elastic fibre stain, showing the distribution of elastic tissue around a large nest of cells and in the surrounding stroma.

pletely surrounded with elastic tissue and in some places the areas themselves appeared in groups of three and four. Besides the above distribution there were also numbers of fibrils of elastic tissue running in the connective tissue strands in double lines as if the remains of a vessel no longer patent. It was with the high power, however, that the very large amount of very fine elastic fibrils running through the sections could be made out following mainly the white fibrous tissue framework but often seen among the cells of the growth with apparently no other connective tissue accompanying them.

Many of the groups of cells were quite devoid of elastic fibrils around them.

There was, apparently, an increase in the amount of elastic tissue in this growth, for in comparison with three normal

breasts two from cases younger than the patient from which the present growth was removed," and three other carcinomata of the mamma, this growth contained a very much larger amount than any of the others. There were also so many minute fibrils differing from that around the vessels and ducts found through the growth away from their apparent origin, that the increase in amount seemed more probable.

While Fibrous Tissue and Reticulum.—Mall's preparation showed a network of strands varying in width from the thickness of writing paper to six or seven times this width, with meshes varying in size from a pinpoint to a pinhead. These meshes were quite clear and appeared as open spaces throughout the section.

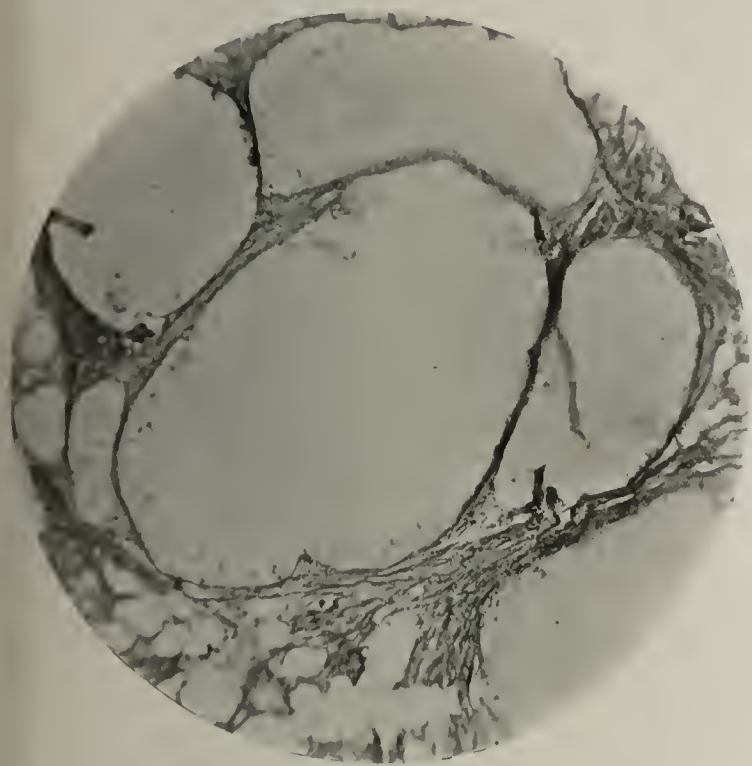


FIG. 3.—Section of a carcinoma of the breast No. 6, digested by Spalteholz' method, showing a group of cell spaces outlined by bundles of wavy fibrils and the entire absence of tissue of any kind in these spaces.

In places the connective tissue forming the network was collected into masses of considerable size up to an eighth or sixteenth of an inch in size. In other places the larger strands surrounded an open space which was subdivided into two or more smaller meshes by threads of the smallest width. The meshes were for the most part more or less circular in outline.

Sections were examined with low power magnification. The meshes were nearly all quite clear; some, however, had projecting into them from the strands which surrounded them the free ends of the fibrils of which these were composed.

The strands forming the network were composed of minute fibres running in a more or less parallel direction intermingling with one another and for the most part quite wavy, so

much so that in places, instead of running a continuous course, certain fibrils appeared as a succession of minute spirillae. The majority of the fibres could be traced throughout their course.

In many places there was a cross fibrillation, with longitudinal fibrils underlying it, both free ends of the former being seen, evidently the fibrils of the third dimension of the cell space.

In the thinner portions of the section a bundle of fibrils could often be traced down one side of a mesh and curving around a second side, then at the third side dividing some of the fibrils, continuing around the same mesh, while others passed in another direction in the strand between two adjoining meshes and so on, intimately interlacing with one another.

With the high power the finer fibrillary nature of the stroma was much clearer but there was no branching or anastomosis of the fibrils, each being traceable along its course without interruption.

Spalteholz' preparation showed a number of absolutely clear spaces outlined by wavy fibrils in bundles which in some places completely surrounded them, while in others they were continued onward between two adjoining spaces after passing around one or two sides of a mesh. These clear spaces in the control specimen were filled with the cells of the growth and evidently these had no intercellular substance between them. The rest of the section was occupied by bundles of wavy white fibrous tissue fibrils which frequently separated, leaving clear spaces which were in the control specimen filled with small groups of cells.

Mallory's and Van Gieson's stains threw no additional light upon the distribution of the connective tissue in this growth.

Specimen No. 7 was from a small round and spindle-celled sarcoma removed from the thigh of a woman 59 years of age. The tumor commenced in the adductor muscles of the thigh and extended downward in the muscles to the popliteal space. It did not involve the muscles about the knee joint, but passed between the bones of the leg and involved the muscles on the anterior aspect of this. There were also large glands on the front of the thigh of similar structure. In the thigh it completely surrounded the femoral vessels and extended onward between the muscles four or five centimetres. In the popliteal space it surrounded the popliteal vessels. Portions were obtained from the growth in the thigh through the femoral vessels and from the outside of the growth.

Elastic Tissue.—The fresh specimens, both the teased and the frozen section, stained with magenta showed considerable numbers of elastic fibres varying in size and character from the fine branching fibres similar to those in areolar tissue to the coarser curly fibres resembling those in the ligamentum nuchae. These fibres ran among the cells of the growth and were found both in the section taken through the femoral vessels and in that from the outside of the growth.

In the Zenker preparation, stained by Weigert's method, the blue-stained elastic fibres were plainly visible to the naked eye. Under the low power the sections were seen to be

"The elastic tissue apparently decreases in amount as the mamma atrophies after the menopause.

divided into lobules of different size by strands of white fibrous tissue, the lobules being closely packed with the cells of the growth with very little evidence of intercellular tissue. The elastic fibres occurred in the midst of the strands of white fibrous tissue and were most abundant in the largest strands but also in places running among the cells.

In the strands they existed as very fine straight branching fibres with free curling ends and also as short curly fibres, due possibly to both ends being free. They occurred also here and there in the section as mentioned above as curly fibrils running among the cells.

In the section near the femoral vessels the elastic tissue was much more abundant. With the high power the branching of the elastic fibrils was more apparent. Some of the white fibrous tissue strands were quite free from the blue fibres, and as one proceeded from the femoral vessels outward the amount of elastic tissue grew less, although it was still

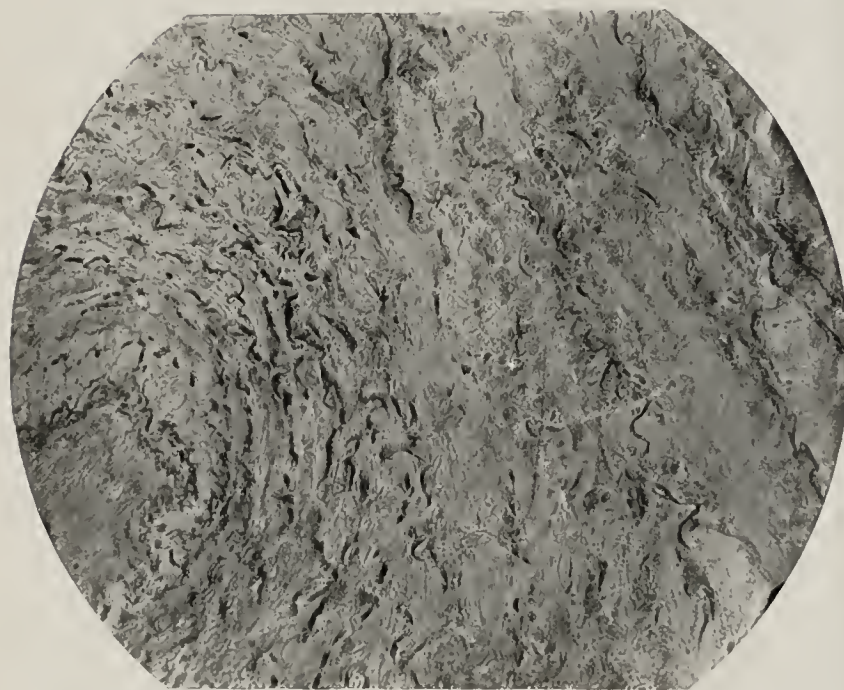


FIG. 4.—Section of sarcoma No. 7, stained by Weigert's method for elastic fibres, showing in dark curling lines the distribution of the elastic fibres. At one side of the section the femoral vessel is seen outlined by elastic tissue and surrounding this are seen layers of elastic fibres lying among the cells of the growth alternating with layers of white fibrous tissue.

present in considerable quantity in the sections from the outside of the growth.

A very peculiar arrangement was present around the femoral vessels. The small round cells had encroached upon the walls of the vessel to the endothelial lining, and from this outward were ranged in definite order layers of small round cells with elastic fibres among them, succeeded by layers of white fibrous tissue with very few elastic fibres one above the other for many layers. The fibres near the vessels were, as a rule, much thicker than those found in the outskirts of the growth.

Unna's orcein stain gave a very similar picture to the above with the elastic tissue stained a silky brown.

From the very large amount of elastic tissue found in this growth and from its varying character it would seem fair to conclude that there was considerable new formation of this tissue.

White Fibrous Tissue and Reticulum. Mall's Preparation.—For purposes of description the fibres forming this section after digestion may be divided into two groups:

1. Long wavy, more or less parallel fibres running in bundles through the sections, the fibres interlacing with one another. These were evidently white fibrous tissue, and in the control specimen this tissue divided the section into lobules and in the Weigert preparation it carried the elastic fibres.

2. Exceedingly fine fibrils which formed the ground work and main portion of the section and lay between the bundles of the first group. They formed a very minute meshwork running in every direction, definitely branching and anastomosing and presenting very much the appearance of reticulum.

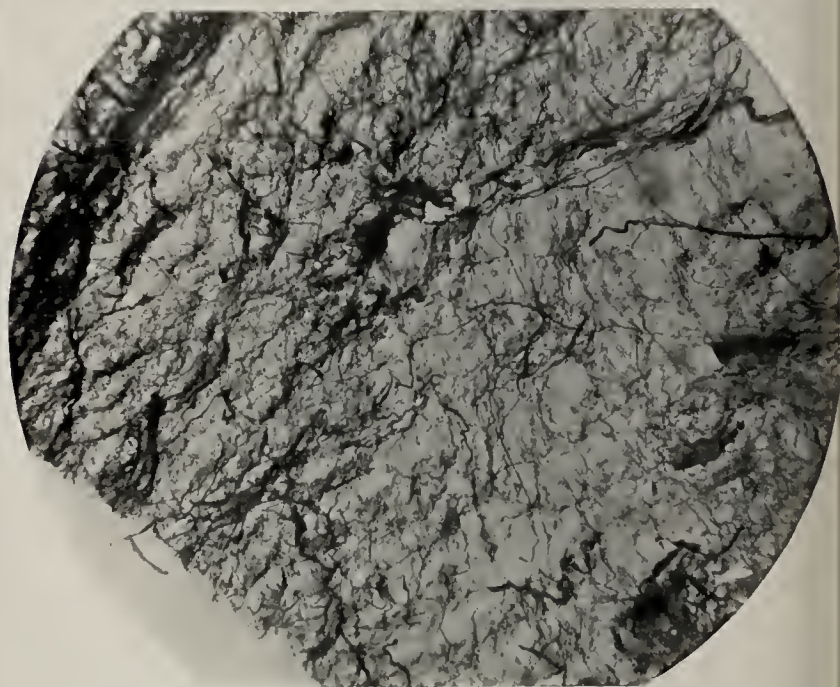


FIG. 5.—Section of sarcoma No. 7, digested by Mall's method showing the strands of wavy parallel fibrils and the groundwork of minute reticular fibrils occupying the remaining portion of the section. The appearance of a focal origin of these fibrils is quite evident in certain spots.

of normal glands. In some places the fibrils appeared to arise from focal points spreading out in all directions and uniting with fibrils from other points.

Under the high power the fibres of the first groups appeared as above but in the reticular network the branching and anastomosing of the fibrils was much more evident. This network seemed to have no direct connection with the first group but extended a short distance among its fibres as if to gain anchorage there, for in the centre of these bundles they were not nearly so evident.

Throughout the section the apparent focal origin of these fibrils may be due to four or five of these overlying each other at a certain spot.

Spalteholz' Preparation.—These sections were much thinner

than those by Mall's method, but showed the same points of interest: the strands of white fibrous tissue dividing the section into lobules, and between these strands, and forming the balance of the section, an exceedingly minute network of delicate fibrils which branch and anastomose, the meshes of which were in the control specimen occupied by the round and spindle cells of the growth, by single cells in most cases, but in some cases apparently by groups of two or three or possibly more. However, in those spaces which were occupied by groups of cells there was often seen in this specimen a small jutting branch as if it had been divided in cutting the section. The apparent focal origin of these fibrils was also noticed in these sections.

Specimen No. 9 was from a carcinoma of the uterus.

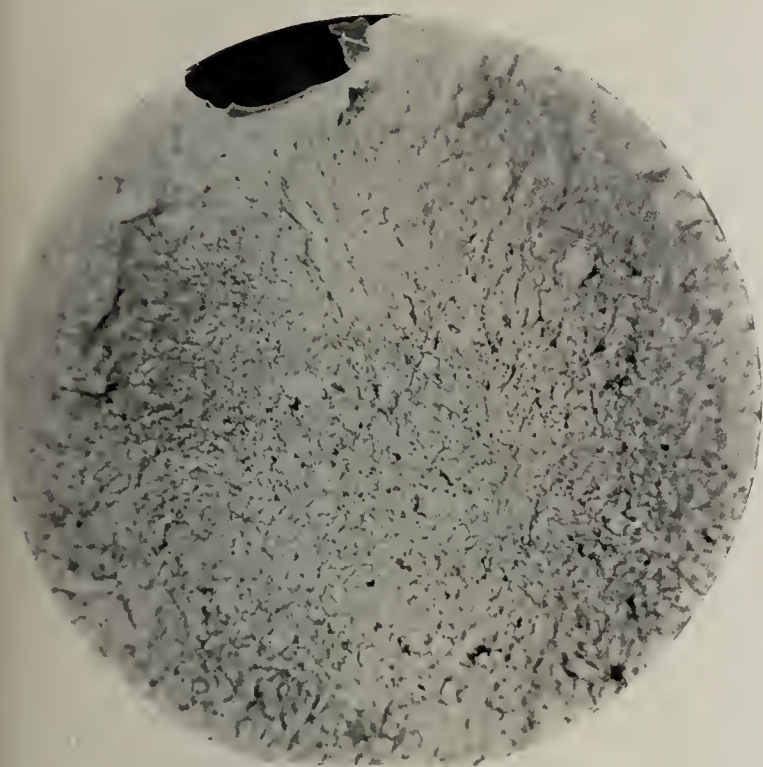


FIG. 6.—Section of sarcoma No. 7 digested by Spalteholtz' method, showing the reticular network with the branching and anastomosis of the fibrils.

It showed no elastic fibres in the fresh preparations but in the hardened section stained by Weigert's stain there were seen in the connective-tissue stroma minute curly fibrils extending for some distance from the vessel's wall, from which they had probably arisen.

White Fibrous Tissue.—The sections studied by Mall's method were too thick for accurate observation but the clear spaces of the carcinomatous growth were clearly seen outlined by bundles of wavy parallel fibres of white fibrous tissue.

In Spalteholtz' preparation the cell nests and groups of cell nests lay embedded in the connective tissue of the muscle wall but were separated from the same by bundles of wavy parallel fibres. These bundles formed a delicate framework, enclosing large meshes which were quite clear in the digested section and filled with cells in the control specimen. Fre-

quently the bundles after passing around one side of a mesh would divide into two smaller bundles which would then take part in the formation of the walls of adjoining meshes. Or again, complete rings of four or five wavy fibres were found in apposition at certain points, leaving between them a clear space, which space was also filled with cells in the control section.

The Van Gieson and Mallory preparations showed the closely packed cell nests lying in the muscle wall of the uterus surrounded by connective tissue, but without the slightest evidence of intercellular tissue.

Specimen No. 10 was from a small round-celled alveolar sarcoma arising from the periosteum of the tibia and invading the tibialis anticus muscle in a girl thirteen years of age. It involved the popliteal glands and also a chain of glands extending along the sciatic nerve.

The growth was exceedingly soft and on cutting it a creamy fluid was expressed.

No elastic tissue was found except around the blood-vessels.

In the preparation by Mall's method the connective tissue was very abundant and disposed in a rather coarse network with comparatively thick strands enclosing varying sized meshes, which to the naked eye appeared quite clear.

Under the low power the section was seen to be composed of a network of thick strands leaving meshes of varying size and shape. The strands were composed of bundles of minute fibres which ran a comparatively straight course. The fibres could often be traced curving around certain meshes, interlacing with fibres going in an opposite direction and continuing on their course around and between neighboring meshes. The meshes were for the most part quite clear. In some, however, there was seen a minute reticular network, the fibrils of which branched and anastomosed.

The meshes in the control specimens were partially filled with small round cells. In many places the meshes were divided by single fibres into smaller meshes, and in some portions of the section where the fibrous tissue was most abundant there was found a definite reticular network outlined by bundles of wavy fibrils. This network was composed of anastomosing and branching fibrils similar to that described in case No. 7. The small meshes of this network were filled with the cells of the growth.

The larger meshes were so loosely filled with cells in the stained specimens that it would seem probable that they had contained also the creamy fluid which was expressed on cutting the fresh tissue.

In Spalteholtz' preparation there was no connected network on account of the thinness of the section. It was composed of minute wavy fibrils running in various directions and outlining irregular spaces which in the control specimen were loosely filled with cells. The white fibrous tissue framework was here of a very loose texture and the interstices left by this separation of its fibres were filled with small round cells in the control section.

In the midst of the clear spaces were frequently seen cir-

cular wavy fibrils completely enclosing small spaces which were also filled with cells in the undigested specimen.

Numerous vessels in the undigested section were represented in the digested section by small rings of connective tissue lying in the framework.

The stained specimens showed numbers of groups of muscle fibres lying among the cells of the growth.

Specimen No. 11 was taken from a carcinoma of the uterus and contained only a very small amount of carcinomatous tissue.

No elastin was present except around the blood-vessels. The other preparations resembled carcinoma No. 9 in every way.

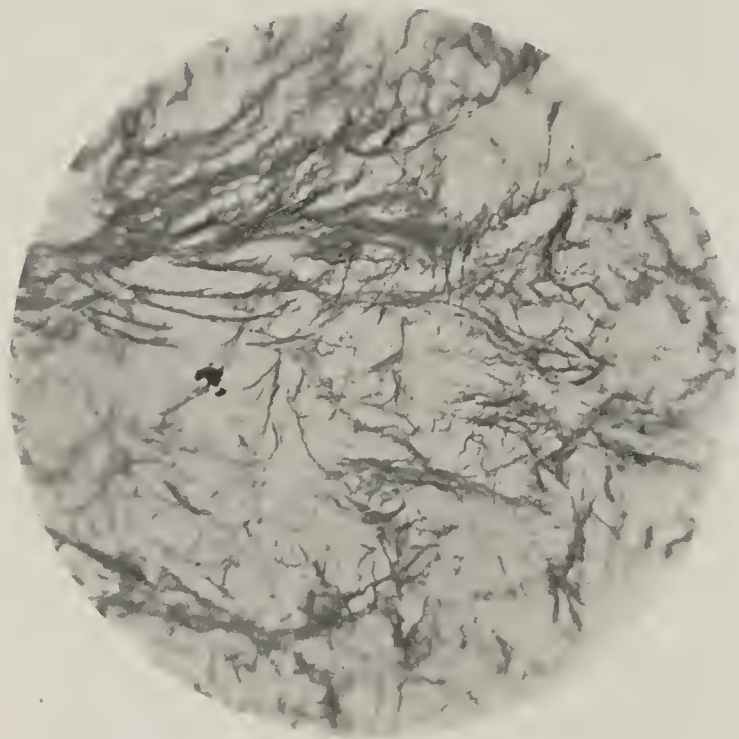


FIG. 7.—Section of scirrhus carcinoma of the breast No. 12, by Mall's method, showing the distribution of white fibrous tissue around the small irregular clear cell spaces.

Specimen No. 12 was a scirrhus carcinoma of the breast from a woman 49 years of age. The growth was of six months' duration and involved also the axillary glands on the same side. The nipple was retracted and the skin adherent to the growth.

This growth showed both in fresh and hardened preparations considerable numbers of elastic fibres around the vessels and lactiferous ducts; also around certain groups of cells, and scattered as short wavy fibrils through the abundant connective-tissue stroma.

In the fresh digested specimen the white fibrous tissue was very abundant in bundles of fine wavy parallel fibres running in every direction and enclosing spaces of varying size. The bundles were in many places very thick and the fibres composing them very close together; these, however, gradually spread out leaving in their midst small clear spaces. Or again, branches from these larger bundles would gradually

thin out and divide to enclose clear spaces and frequently these spaces were separated from one another by a single fibril. There was no anastomosis of fibrils and no reticular network. The clear spaces were filled in the control specimen by small groups of cells, the largest containing probably fifteen or twenty cells, the smallest only two or three.

Spalteholz' preparation gave in a thinner section much the same picture. Here the wavy fibres were present in bundles which gradually spread out and divided to enclose clear spaces of varying size which were occupied by the cells of the growth in the control section.

This specimen differed from Nos. 6 and 18 (*a*) in the very much larger amount of connective tissue; (*b*) in the smaller and irregular grouping of the cells, and (*c*) in the smaller amount of elastic tissue.

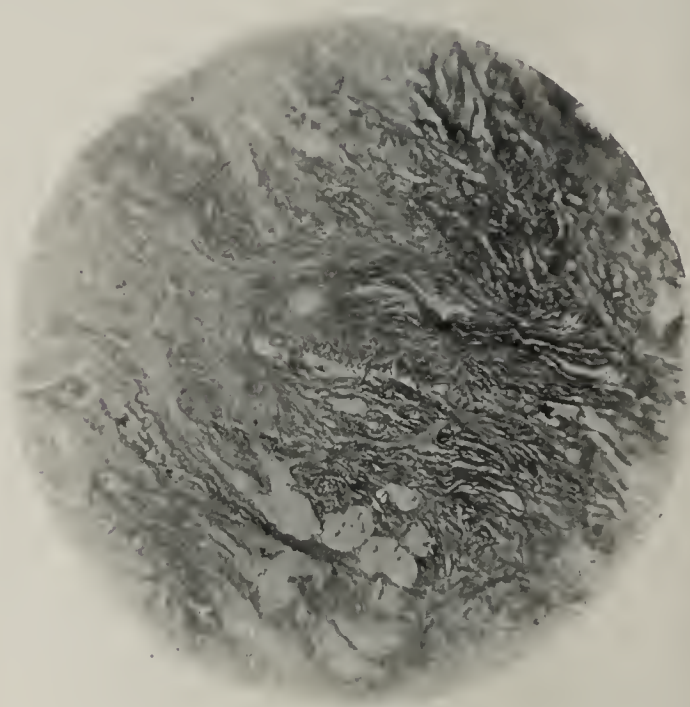


FIG. 8.—Section of fibro-sarcoma of the liver No. 13, by Spalteholz' method, showing the large amount of fibrous tissue surrounding the clear cell spaces.

Specimens Nos. 13 and 14 were from carcinomata of the liver and rectum in the same individual. The growth was primary in the rectum, where it formed a mass 7 x 6 cm. in size and filled the whole pelvis. There were numerous secondary nodules in the liver from 2 mm. to 5 cm. in diameter. They were firm, opaque and yellowish and surrounded by a zone of greenish-yellow liver substance. The rectal growth had eroded the sacrum and was adherent to it.

These two specimens were of so similar a nature that only one description will be given for both, noting any differences that existed.

The specimens when obtained had already been kept about four days in the ice chest, so that the fresh preparations for elastic tissue were not satisfactory. In the rectal growth, however, by Weigert's stain a few scattered elastic fibres were found running in the midst of the general white fibrous stroma.

White Fibrous Tissue.—Both growths contained a great deal of connective tissue, the liver growth more than the rectal growth. The type was the same in both, bundles of wavy more or less parallel fibres running in every direction and outlining clear spaces of varying size which were filled with epithelial cells in the control section. These sections resembled very much the scirrhous growths from the breast, but the fibrous tissue was here even more abundant.

In Spalteholtz' preparation the section was thin, the thickness of two or three fibres. The fibres ran in many directions, their further course in any one direction ceasing when they encountered bundles running in an opposite direction. In the midst of the bundles minute openings were seen where the constituent fibrils separated slightly from one another, and in these spaces the connective tissue corpuscles were seen to lie in the control specimen. Here also the curving of the fibres around two or more sides of a clear space and onward between two adjacent spaces was clearly seen.

Specimen No. 16 was from a scirrhous carcinoma of the breast of eight years' growth in a woman forty-four years of age.

This growth resembled very much that described in No. 12. It contained, however, many more elastic fibres running through the white fibrous stroma, but these were confined to the stroma and to the ducts and blood-vessels, and did not in any case surround groups of cells, nor were they nearly so abundant as in case No. 6.

Specimen No. 17 was from a small round and spindle-cell sarcoma taken from the axillary region. It had a thin translucent capsule and could so be separated from the surrounding tissues, the connection consisting only of fine branching connective-tissue fibres and numerous small blood-vessels. Its origin was evidently from the intermuscular connective tissue and the growth itself was soft, elastic and lobulated, measuring $13\frac{1}{2} \times 10 \times 18$ cm. Its duration was 20 months, and it involved also a number of glands in the supra-clavicular fossa.

No elastic fibres were found in either the fresh or hardened preparations.

The digested specimens, both by Mall's and Spalteholtz' method, showed the same reticular network as that described in section No. 7, and also the same white fibrous bundles enclosing this network. Neither the Van Gieson nor Mallory preparations showed the large amount present nor its distribution.

Specimen No. 18 was from a carcinoma of the breast of four months' growth in a woman thirty-seven years of age. At removal it was present as a hard regular mass freely movable and measuring 4×2 cm. in size.

This was an exceedingly cellular growth, thus differing from cases No. 12 and 16, but it resembled very much case No. 6 both in the distribution of elastic and white fibrous tissue and in the type of cell of which it was composed, except

that in the latter instance No. 18 was of a much more malignant type filled with young cells and almost resembling a small round-celled sarcoma.

Elastic Tissue.—The elastic tissue here was disposed in a very similar way to No. 6, but was not so abundant.

In this growth a comparison was made with a portion of normal breast from the same case with reference to the amount and distribution of the elastic tissue with the following result: that the elastic tissue in the growth was found to be not so abundant as in the normal breast, but differed somewhat in distribution. In the normal structure the elastic tissue was confined to the coats of the vessels and lactiferous ducts occasionally occurring in bundles in the stroma of the gland, while in the growth, besides being around the vessels, it was present surrounding large groups of cells, evidently invaded ducts, and as minute wavy fibrils was most abundant in the stroma, but frequently was found in among the cells with apparently no white fibrous tissue accompanying it; also as bundles of fibres which were infiltrated with epithelial cells.



FIG. 9.—Reticular network from sarcoma of axilla No. 18, prepared by Mall's method.

In spite of the very cellular condition of the growth it presented on digestion the distribution of fibrous tissue described under case No. 6 of large cell spaces with no intercellular network.

CONCLUSIONS.

1. Elastic fibres are frequently present in new growths: (a) in the stroma; (b) among the cells; (c) around the blood-vessels, and (d) in breast tumors around the lactiferous ducts which have been included and invaded by the growth.

2. When present they are usually in connection with pre-existing elastic-tissue elements in the original tissue in which the tumor has grown.

3. New formation probably occurs but can only be determined by a comparison of that present in the growth with that present in the normal tissue in which the growth has arisen.

4. Sarcomata present a large increase in connective tissue and possess an exceedingly fine intercellular reticular network very similar in structure to the reticulum present in normal glandular tissue.

5. Carcinomata possess a stroma of white fibrous tissue, outlining the cell spaces, but have no intercellular network.

6. The digestion methods present a possible means of diagnosis between carcinomata and sarcomata in doubtful cases.

7. Uterine myomata have a very large amount of connective tissue both of a white fibrous and reticular nature, possessing a connective-tissue capsule for each muscle cell; and it would be more correctly termed fibromyomata.

ON THE RELATION OF THE ELECTRICAL CONDUCTIVITY OF BLOOD-SERUM TO ITS ALLEGED BACTERICIDAL POWER.

BY EMMA LOOTZ AND ALICE WELD TALLANT.

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

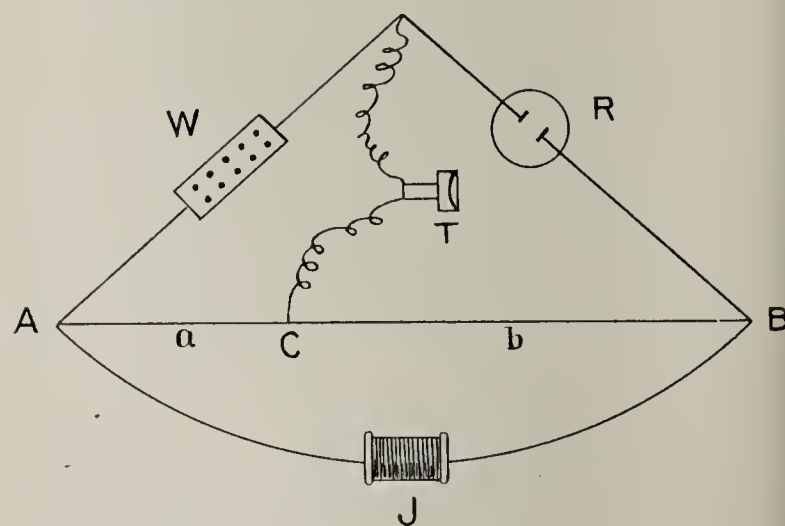
As is well known, it is asserted that blood-serum possesses certain bactericidal properties, and many experiments tend to show that these properties are lost when the serum is heated to from 55-60° C. In a recent article Baumgarten¹ advances the theory that the bactericidal power of the serum is due, not to the actual existence of bactericidal substances in it, but to the fact that bacteria, in being transferred from their natural surroundings to another medium, undergo sudden changes in assimilation and plasmolysis.

Following the line of thought of this article, Dr. L. F. Barker suggested that the writers undertake experiments to discover whether any physico-chemical change could be demonstrated in serum heated to the specified temperature. Electro-chemical examination of the conductivity of the serum was the method chosen, and the following experiments were carried out:

The serum was carefully obtained from dog's blood in the pathological laboratory; the work on conductivity was done in the Chemical Laboratory of the Johns Hopkins University, through the courtesy of Dr. Harry C. Jones. The apparatus used is described by Dr. Jones² as follows:

"J is a small induction coil, with only one or two layers of wire. A larger coil must not be used, since it does not give a sharp tone minimum in the telephone. The coil, tuned to a very high pitch, should be enclosed in a box surrounded by a poor conductor of sound, and placed at some distance from the bridge where the reading is to be made. The coil is driven by a storage cell of medium size. A platinum wire, or better, one of manganese alloy, which has a small temperature coefficient of resistance, is tightly stretched over the meter stick AB, which is carefully divided into millimeters. A rheostat W, whose total resistance amounts to 11,110 ohms, is convenient. The resistance vessel R, containing the solution and electrodes—the electrodes are cut from

thick sheet platinum, and into each plate a stout platinum wire, about an inch in length, is welded. Glass tubes are sealed on to the platinum wires and electrode plates, by means of sealing glass. . . . These tubes pass tightly through a rubber cap, which fits over the glass vessel. They are filled to a convenient height with mercury, and electrical connection, established by means of copper wires, which dip into the mercury. One arm of the telephone, T, is thrown into the circuit between the rheostat and the resistance, and the other arm is connected with the bridge wire, by means of a slider. This is moved along the wire until that point is found at



which the hum of the induction coil ceases to be heard in the telephone. Let this be some point C, and let us represent AC by a, and BC by b, the resistance of the solution in the vessel R by r, and the resistance in ohms in the rheostat by w; then, from the principle of the bridge, we have

$$ra = wb$$

$$r = \frac{wb}{a}$$

But the conductivity of a solution, c, is the reciprocal of the resistance, r; therefore,

¹ P. Baumgarten. Beiträge zur Lehre von der natürlichen Immunität. Berl. klin. Wehnschr., No. 41, Oct. 9, 1899.

² Harry C. Jones. The Freezing-Point, Boiling-Point and Conductivity Methods.

$$c = \frac{a}{wb}$$

... A cell-constant, C, must be introduced and determined for each cell before it can be employed for conductivity measurements."

In calculating the molecular conductivity of a substance, its molecular concentration must be taken into account, but in these experiments this was not considered necessary. The results given in the tables express the conductivity simply as the reciprocal of the resistance, r, according to the formula

$$c = C \frac{va}{wb}$$

The material used in the experiments was dog-serum, obtained under proper aseptic precautions. In the first experiment the serum was heated from 24 to 70° C., and its conductivity tested at the following temperatures: 24°, 30°, 38°, 50°, 51°, 52°, 53°, 54°, 55°, 56°, 57°, 58°, 59°, 60°, 70°. It was then cooled to 38°, and its conductivity again tested. The material was kept at each of these temperatures long enough to ensure a constant reading, and the temperature was not raised above 70°, on account of the changes in concentration which would have occurred from evaporation.

Five more experiments were performed with serum taken from different dogs. The conductivity was tested at 24°, the material was then heated to 57° and kept at this temperature for one hour, after which it was slowly cooled to 24°, and

the conductivity again tested, to discover if any change had taken place. The results of these experiments are incorporated in the following tables. The figures in each case represent the mean of three readings.

EXPERIMENT I.

24°	11.323	55°	19.283
30°	12.753	56°	19.643
38°	14.696	57°	19.881
50°	17.873	58°	20.133
51°	18.16	59°	20.41
52°	18.526	60°	20.73
53°	18.8	70°	23.253
54°	19.053	After cooling—	
		38°	14.743

The gradual increase in conductivity is, of course, due to the rise in temperature.

		Before heating to 57° C. for 1 hour.	After heating to 57° C. for 1 hr. and again cooling to 24° C.
Experiment II.	24°	11.436	11.466
Experiment III.	24°	11.786	11.763
Experiment IV.	24°	11.48	11.486
Experiment V.	24°	11.446	11.446
Experiment VI.	24°	10.546	10.56

The results of the above experiments go to prove that the alleged loss of bactericidal power in blood-serum heated to 57° is not due to any chemico-physical change which can be demonstrated by the conductivity method.

A CONTRIBUTION TO THE STUDY OF MALIGNANT TUMORS ARISING IN CONGENITAL MOLES.

BY R. H. WHITEHEAD, M. D., *Chapel Hill, N. C.*

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

In 1893 Unna¹ announced his belief that melanotic malignant tumors which originate in pigmented moles should be classed as carcinomata. He based his opinion upon an examination of some tumors of this sort, and especially upon a study of moles obtained from newborn and very young children. According to him, the groups of pigmented cells commonly found in moles are derived from the epidermis during embryonic life or early childhood by being cut off from the interpapillary processes of the rete Malpighii, and afterwards losing their prickles and undergoing other metaplastic changes. He concluded, therefore, that melanotic tumors arising in moles are not sarcomata, but carcinomata.

Since, at that time, it was generally held that the so-called nevus cells were of endothelial origin, Unna's statement aroused considerable opposition. Green² denied the epider-

mal genesis of the nævus cells, and pointed out that there is no relation between the amount of pigment in them and that in the epidermis—that it may be present in either situation while absent from the other.

Then Bauer,³ a pupil of Ribbert, investigated the subject, and reached conclusions quite the opposite of those of Unna, even after examining Unna preparations. He convinced himself that the nævus cells were of endothelial origin, and stated, furthermore, that the individual cells in the groups were separated from one another by a fine fibrous network, and that they were frequently branched so as to resemble stellate connective-tissue cells.

Lubarsch⁴ stated that he had examined a considerable number of moles in newborn and young children, and had

¹ Unna, P. G. Nævi und Nævocarcinome. Berl. klin. Wchnbr., 1893, XXX, 14.

² Green, L. Ueber Nævi pigmentosi. Virchow's Archiv, 1893, CXXIV, 331.

³ Bauer, C. Ueber endotheliale Hautwarzen und ihre Beziehungen zum Sarcom. Virchow's Archiv, 1895, CXLII, 407.

⁴ Lubarsch-Ostertag. Ergeb. d. allg. Pathol., etc., Wiesbaden, 1896, Bd. II, S. 379.

not been able to detect any correspondence between the nævus cells and those of the epidermis.

Unna, however, did not fail to find supporters. Delbanco,⁵ as the result of his study of two moles, stated that the inter-papillary processes of the epidermis are frequently in direct connection with the groups of nævus cells, and that, owing to proliferation of the stroma of the mole, numerous epidermal cells are separated off into groups and afterwards displaced into the lymph vessels.

Kromayer⁶ rejected Delbanco's conclusion that the nævus cells are contained in lymph vessels, but agreed with him and with Unna in deriving them from the epidermis. This investigator describes in the moles of infants cyst-like spaces filled with cells containing vesicular nuclei. They are situated in the epidermis, between the epidermis and the subjacent connective tissue, or entirely within the latter. He thinks that all of these groups of cells become enclosed by connective tissue later on, and that then the cells throw off fibres, until finally little is left of the individual cells save nuclei closely applied to fibres—that, in fine, the epithelial are metamorphosed into connective-tissue cells.

Lubarsch,⁷ in a critical review of the work done up to that time, expressed the opinion that the researches of Unna, Delbanco, and Kromayer were individual interpretations of microscopic pictures rather than objective descriptions of appearances actually observed, and that their illustrations were susceptible of more than one interpretation. Thus, he claimed that Kromayer's picture representing nests of nævus cells in the epidermis could be reproduced by oblique sections of the skin in conditions characterized by elevations of the epidermis, as the result of growing or proliferating papillæ. Nor was he willing to accept Kromayer's metaplasia of epithelial into connective-tissue cells, holding that the law of the legitimate succession of differentiated cells was too well established to be surrendered on such proof as Kromayer presented. He criticized also the method with which Kromayer worked, and was not convinced by his original preparations. Still, he was unwilling to deny the possible existence of epithelial nævi.

A little later Scheuber⁸ made serial sections of several pigmented moles, and convinced himself that Unna's view as to the origin of nævus cells was correct.

Recently Gilchrist⁹ has made an investigation of the subject, and, from the study of a pigmented mole in an infant, arrived at the conclusion that the nævus cells are developed in the way described by Unna.

⁵ Delbanco, E. Epithelialer Nævus. *Monatsh. f. prakt. Dermat.*, 1896, XXII, 105.

⁶ Kromayer, E. Zur Histogenese der weichen Hautnævi. *Dermat. Ztschr.*, 1896, III, 263.

⁷ Op. cit., S. 591.

⁸ Scheuber, A. Ueber den Ursprung der weichen Nævi. *Arch. f. Dermat. u. Syph.*, 1898, XLIV, 175.

⁹ Gilchrist, T. C. On Malignant Growths Arising from Pigmented Moles. *Journ. Cut. and Genito-Urin. Dis.*, 1899, XVII, 117.

Finally, Schalek¹⁰ has studied some pigmented moles and melanotic tumors of the skin, and has satisfied himself of the correctness of Unna's views.

In the midst of such difference of opinion one finds it difficult to reach a definite conclusion as to the nature of the nævus cells; but the pictures of Scheuber and of Gilchrist are, to say the least, exceedingly suggestive, and one may fairly be permitted to hold the view that in some moles, at least, the groups of cells are modified epithelial cells of epidermal origin. Should a tumor spring from such cells, we should, naturally, expect it to follow the type of carcinoma. This expectation, however, is not always realized. Unna indeed, states that all of these tumors which he has studied presented the structure of alveolar carcinoma (carcinoma simplex). On the other hand, the nine tumors of this class which I have been able to examine, had that histologic structure which most pathologists have agreed to call alveolar sarcoma, and were so pronounced by competent observers. While we may well hesitate to be dogmatic in such matter yet one is reluctant to regard as a carcinoma a tumor which presents so many characteristics of the sarcomata.

The following cases are reported not so much with the hope of throwing new light upon this vexed question as rather to call attention to the fact that tumors may spring from congenital moles which represent the same processes as those going on in the melanotic tumors, with the exception that they totally lack true melanotic pigment.

CASE 1.—The subject of this tumor was a white man aged 47 years. He had noticed, as long as he could remember, "black mole" on the front of his right forearm a little above the wrist. For the last few weeks this had been enlarging rapidly, so that when I saw him there was in the situation mentioned a perfectly black tumor, conical in shape, and about 2 cm. high. The color was due largely to clotted blood, with which the tumor was encrusted, owing to frequent hemorrhages. The growth was removed by incisions carried widely into apparently healthy tissues. Eight months afterwards I learned that he had died "with tumors all over him." They were estimated as at least 200 in number, were situated in and beneath the skin, and varied in size from that of a pin to that of a hen's egg. Towards the end of his life he suffered much from frequent painful micturition, and on several occasions passed in his urine fleshy masses believed by his medical attendant to be pieces of tumor.

On section the tumor was deeply pigmented in places, and was spongy and friable, tending to crumble to bits when handled at all roughly. It arose by a broad, short pedicle little more than one cm. thick.

In longitudinal sections through the pedicle the latter was seen to be formed by dense fibrous tissue containing swe-

¹⁰ Schalek, A. Contribution to the Histogenesis of Melanocarcinoma of the Skin. *Journ. Cut. and Genito-Urin. Dis.*, 1900, XVI, 145.

¹¹ Unna, P. G., op. cit.

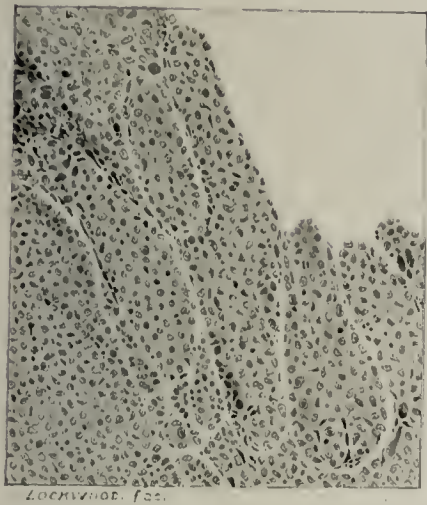


FIG. 1.—Shows structure of the tumor in Case I.

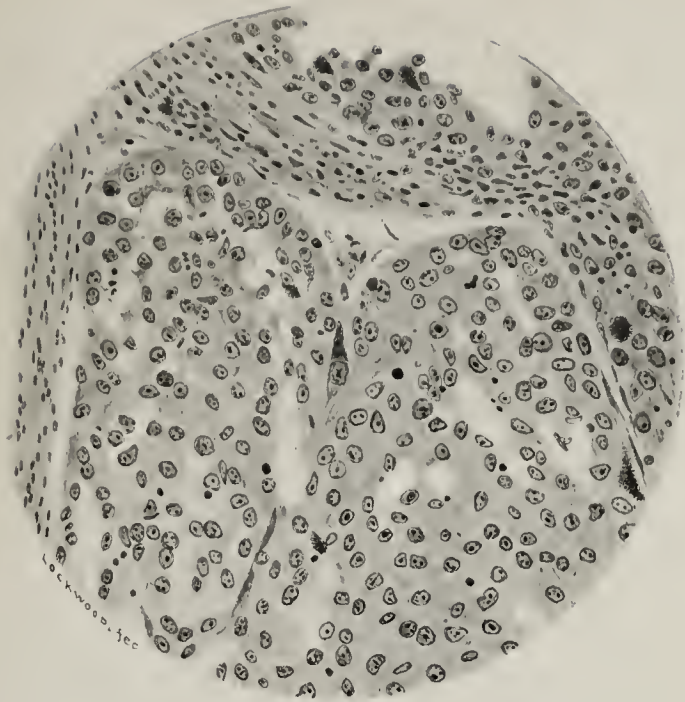


FIG. 2, CASE I.—Shows the intraalveolar reticulum.



FIG. 3, CASE II.—Portion of a cell-mass of the first variety.

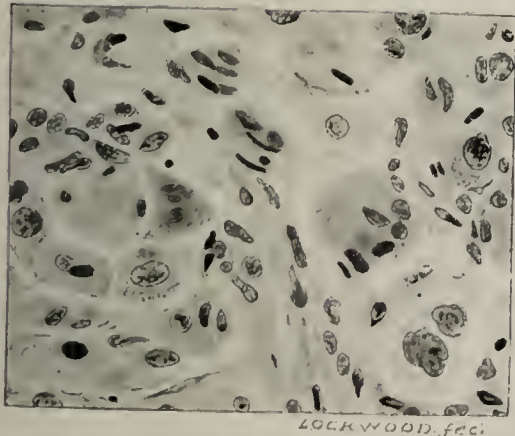


FIG. 4, CASE II.—Portion of a cell-mass of the second variety.



FIG. 5, CASE II.—Transition from a mass of the first to one of the second variety.

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and sebaceous glands and a few hair roots. Proceeding towards the tumor proper, many young capillaries are encountered containing numerous polymorphonuclear leucocytes and surrounded, here and there, by groups of small round cells. In this region pigment begins to appear as small masses of a yellow-brown color. In some cases these masses are confined in branched cells; in others I am unable to decide whether they are intra- or extracellular in situation. Near the pedicle the arrangement of the tumor is alveolar in character, though the stroma soon becomes very scanty, the walls of the alveoli being quite delicate and furnished by a few spindle-shaped cells. The cells within the alveoli are, in the main, large and polygonal; their nuclei are fairly constant in size and appearance, being vesicular with nucleoli and grains of chromatin. Cells with several or budding nuclei are frequently seen. In certain alveoli from which some of the cells have been removed by shaking, it can be seen that the cells are separated from one another by a very fine reticulum, which appears to consist in large part of processes from the cells themselves. Many of the cells contain pigment in the form of yellow-brown grains. Farther towards the periphery of the tumor the alveolar is succeeded by what may be termed a diffuse arrangement of the cells. Here the stroma, reduced to a minimum, is represented only by a few parallel rows of endothelial cells running here and there through the large masses of cells. It is difficult in this region to detect any intercellular substance; occasionally one sees cells with fibrillar processes. Very common are exceedingly large cells, spherical and multinucleated, containing many granules of pigment. The superficial portions of the tumor are inflamed, necrotic, and infiltrated with blood. The areas still living consist of large vascular spaces lined by endothelium and surrounded by masses of tumor cells. The epidermis near the pedicle is thickened, but no connection can be made out between it and the tumor proper. In other situations the epidermis has broken down before the invading masses of tumor cells, which grow through and project beyond it. It has entirely disappeared from over the greater portion of the surface of the tumor. In the thickened epidermis a few epithelial cells were noticed, some of which contained pigment. The tests for iron-containing pigment resulted negatively.

Here we have a typical example, in an advanced stage, of the malignant melanotic growths which spring from the various cells of congenital moles—the *nævocarcinomata* of Naevius, or the alveolar melanotic sarcomata of most authors.

CASE 2.—This tumor was obtained, through the kindness of Dr. C. S. Mangum, from a white woman 50 years old. She consulted Dr. Mangum concerning a large mole situated at the inferior angle of the left scapula. It had been present "all her life," but only recently had been enlarging. Dr. Mangum thought best to remove the mole, especially as there were evidences of beginning ulceration. The subsequent history, unfortunately, could not be fully obtained. It was learned, however, that the wound made by the operation never healed, and that the lymph nodes in the left axilla

soon became enlarged. About eighteen months after the operation she was considered by her family physician to be dying of a malignant tumor of the uterus.

The tumor is about 2 cm. long, and 1 cm. thick. It presents the macroscopical appearances of soft papilloma, its surface being corrugated. It possesses a short, narrow pedicle. On section it is seen to be pigmented in streaks of a dark slate color.

In sections made through the center of the mole including the pedicle, the latter is found composed of fibrous tissue; its arteries are thickened, and there are some patches of small round cells. In these sections the structure is quite suggestive of carcinoma simplex. There are variously shaped alveoli, for the most part long and narrow, whose walls are thick and formed by dense fibrous tissue with scanty spindle cells. The cells within the alveoli are packed closely without visible intercellular substance. They are regular in size and appearance, being rather small polyhedral cells with pale vesicular nuclei. This area, doubtless, consists of normal mole tissue.

Sections made through the other portions of the tumor, however, present a different picture. The most prominent feature is furnished by large, more or less round collections of cells surrounded by capsules of dense fibrous tissue. They are not all alike, but may be divided into two varieties. The more numerous ones are composed, in the main, of small polygonal cells with deeply staining nuclei, though occasionally one sees a very large cell with more than one nucleus. The primary mass of cells is subdivided into much smaller masses by a spindle-celled connective tissue, which runs in from the surrounding connective tissue, and conveys vessels. In most cases this tissue is quite scanty, and often the subdivisions seem to be separated only by narrow cracks, the boundaries of which are the tumor cells, though sometimes a few spindle cells can be seen bordering them. No intercellular substance can be made out between the cells in the subdivisions. In some of the masses the thickness of the connective tissue septa is much greater than in those just described, and then an appearance is produced somewhat like that described in sections through the center of the tumor.

The cell masses of the second variety are not so numerous as those of the first, and are not so sharply circumscribed. The cells composing them are, for the most part, very large and round, and many of them contain more than one nucleus. They are separated from one another by a delicate reticulum, which frequently holds deeply staining nuclei; or several cells may be shut off into small groups by portions of the reticulum. As a rule, the cells towards the periphery of these masses tend to assume the spindle shape, and gradually fade away into the surrounding connective tissue. Areas are observed where a mass of the first variety is passing by gradual transition into one of the second variety. Moreover, in the case of both varieties, columns of cells advance into the surrounding stroma, where they usually tend to the spindle shape.

The stroma of the tumor is furnished by a central trunk of fibrous tissue, which gives off branches here and there to surround the cell masses alluded to. It conveys many blood-

vessels, around which are some patches of small round cells and many plasma cells, and contains scattered, long, narrow spindle nuclei. In several places this tissue is lost in diffuse masses of large spindle-shaped cells, for which it seems to form an intercellular substance.

The surface of the tumor is covered everywhere by epidermis, which is necrotic over a considerable extent of the tumor. Where the epidermis is intact, it is seen to be very thin—it is reduced to two or three layers of cells—and is separated from the subjacent tissue by distinct lines of connective tissue. Some epithelial pegs project from the epidermis, but they, too, are very thin, and show no connection with the tumor cells. The pigment was found chiefly along the course of the blood-vessels and in the most superficial parts of the growth, where hemorrhages had occurred. Much of it responded positively to the ferrocyanide of potassium

test, and the remainder was amorphous hæmatoidin contained largely in polymorphonuclear leucocytes.

In this case, it would seem, the processes which occur in the malignant melanotic tumors are undoubtedly going on—the development of a malignant tumor from the nests of nævus cells in a congenital mole, but with the exception that true melanotic pigment is not present. *A priori*, we should expect to find such tumors, for Green¹² has shown that the nævus cells are not always pigmented, nor are tumors which arise in melanotic tissues invariably melanotic, but I have not been able to find the records of a similar case. Unna¹³ hints at the possible existence of such growths, but makes distinction only of melanotic tumors.

¹² Green, L. *op. cit.*

¹³ Unna, P. G. *Die Histopathologie der Hautkrankheiten*. Berlin, 1894, pp. 746-752.

INORGANIC FERMENTS.¹

BY HARRY C. JONES, PH. D.,

Associate Professor of Physical Chemistry Johns Hopkins University.

A paper bearing this title has recently appeared by Bredig and Müller von Berneek.² The authors first point out certain analogies between the action of ferments and the contact action of metals. Alcohol is oxidized to acetic acid by the oxygen of the air as well by finely divided platinum as by the organic ferment *mycoderma aceti*. Calcium formate is decomposed into calcium carbonate, carbon dioxide and hydrogen, not only by certain bacteria, but by finely divided iridium, rhodium, or ruthenium. Finely divided platinum, palladium, iridium, osmium, etc., have the power of inverting cane sugar, like invertase.

The above relations are, however, only analogies. To determine whether there is any close relation between the action of organic ferments and finely divided metals, some reaction effected by both classes of substances must be carefully studied.

The reaction chosen by the authors of this paper is the decomposition of hydrogen dioxide. This reaction is effected by all organic ferments and, also, by finely divided metals, in the sense of the following equation:



The metal chosen was platinum, and a colloidal solution of this substance was prepared as follows: Two platinum wires about 1 mm. in diameter were immersed in a vessel containing very pure water. These were placed at a convenient distance apart, and a current of from 8 to 12 amperes and 30 to 40 volts passed between them. There was thus formed an arc between the platinum poles beneath the surface of the water. Platinum was torn off from the cathode in a

very finely divided condition, and quickly gave a blackish brown color to the surrounding water. The liquid was then rapidly filtered through a folded filter to remove any large particles of platinum which may have been torn off. The colloidal solution of platinum is a clear, dark brown liquid which, when examined under the microscope, appears to be perfectly homogeneous. The platinum particles must, therefore, be of an order of magnitude less than a wave-length of light. The amount of platinum contained in the solution could be easily determined by treating with a little concentrated hydrochloric acid. The platinum was precipitated and could be filtered off and weighed. The decomposition of hydrogen dioxide by means of this liquid was then studied.

There are two striking characteristics of the action of organic ferments. First, a very small amount of the ferment can effect a large amount of reaction. Second, the ferment itself very probably does not enter, as such, into the reaction.

Bredig and von Berneek studied the action of the colloidal platinum with reference to these two points. They found that a gram-atomic weight of platinum in about 70,000,000 litres of water would appreciably decompose hydrogen dioxide. This showed that an almost infinitesimal amount of the metal was capable of effecting the reaction. Similar results were obtained with other metals and metallic oxides, such as manganese dioxide, cobalt oxide, copper oxide, lead dioxide, etc. The first point of resemblance between the action of organic ferments and of these inorganic substances is thus evidently very close.

The method of testing the second point, whether the metal enters into the reaction, is at first sight not so obvious. Indeed, there is no strictly chemical method for deciding the

¹ Presented to the Johns Hopkins Hospital Medical Society.

² *Ztschr. phys. Chem.* (Jubelband zu van't Hoff), 31, 258.

point. The fact that the platinum remains in the solution after the reaction in the same condition as before, is no proof that it has not entered into the reaction and then came out again as such. There is, however, a physical-chemical method by means of which this problem can be easily and satisfactorily solved. If the platinum does not enter into the reaction but acts only by contact, it is evident that there is only one substance reacting. Such reactions are termed monomolecular. If the platinum does enter into the reaction there are two substances reacting, and such a reaction is termed bimolecular. We can distinguish very readily between monomolecular and bimolecular reactions. Without entering too far into the mathematical side of the problem, it has been shown from the law of Mass Action that for reactions of the first order the expression connecting the time during which the reaction has proceeded with the amount of substance transformed is:

$$\frac{1}{g} \ln \frac{A}{A-X} = C$$

in which g is the time, A the original amount of substance, X the amount decomposed, and C is a constant.

Similarly, for reactions of the second order we have:

$$\frac{1}{g} \frac{X}{A-X} = C$$

in which the symbols have the same significance as above.

To determine the order of the reaction it is only necessary to decide experimentally between these two equations. This is quite simple. It is only necessary to know the amount of hydrogen dioxide with which we start, (A) and to measure the amount transformed (X) in any given time (g). Then substitute these values in the above equations and obtain C . Having done this for any given time, allow the time to vary and measure X for the new time. Again calculate C . Repeat this process for a number of values of g and calculate C in each case from both equations. If the values of C are a constant for varying values of g as calculated by the first equation the reaction is one of the first order. If, on the contrary, it comes out a constant as calculated by the second equation the reaction in question is one of the second order.

In the reaction with which we are dealing, C , as calculated by the first equation, is a constant, and hence the decomposi-

tion of hydrogen dioxide by platinum is a monomolecular reaction. The platinum, therefore, does not enter into the reaction, and we have established the second point of resemblance between the action of organic ferments and that of finely divided platinum.

The most striking analogy between the action of the colloidal platinum and of organic ferments still remains to be considered. It is well known how sensitive organic ferments are to the action of certain poisons. The same phenomenon is manifested by the solution of platinum. Thus, a gram-molecular weight of hydrocyanic acid in one million litres of water reduces, quite appreciably, the action of the platinum solution on hydrogen dioxide. Hydrogen sulphide has also a poisonous action. A gram-molecular weight of the gas dissolved in 345,000 litres of water diminishes the velocity with which the colloidal platinum will decompose hydrogen dioxide, and a solution of hydrogen sulphide ten times as concentrated as the above, reduces the velocity of the reaction nearly to zero. Carbon bisulphide and mercuric chloride also exert a poisonous influence on the solution of platinum, reducing the rate at which it will decompose hydrogen dioxide, and, if present in sufficient quantity, entirely preventing the reaction.

Whatever conclusions may be drawn from this work the fact cannot be disregarded that there are a number of very striking analogies between the action of finely divided platinum and that of organic ferments. While it seems to the reviewer a little premature to draw final conclusions, yet enough has already been done to show that this is a very promising field for investigation. If it should be shown that these analogies are deep-seated, then, work of this kind cannot fail to throw light on the nature of fermentation and similar processes. Metallic platinum in the form of a colloidal solution is one of the simplest substances known to the chemist. Organic ferments are in general very complex. If the action of the two is analogous, then, by studying the action of the simpler substance much light may be thrown on the *modus operandi* of the more complex enzymes.

It is impossible to say at present to just what this work may lead. It is certainly an important step in a direction which is full of promise, and is another example of the way in which physical chemistry is throwing light, not only on chemical and physical problems, but also on biological.

THE STERILIZATION OF CATGUT.

BY G. BROWN MILLER, M. D.,

Resident Gynecologist The Johns Hopkins Hospital.

The value of absorbable suture and ligature materials has for years been so apparent that much work has been done to secure one which would answer the conditions imposed by the requirements of aseptic surgery. Catgut is the cheapest

and best of such materials. Its properties are so well known that an enumeration of them here would be superfluous. The principal objection to its use as sutures or ligatures is the difficulty experienced in its sterilization.

In the spring and summer of 1899 I tested several methods which seemed to me the most promising of the many in use. My endeavor was to secure a method of catgut sterilization so simple in its technique that it could be generally adopted. There are two conditions which must be fulfilled and several which it is desirable to meet in the preparation of catgut for surgical purposes. The first essential condition is, that the *sterilization* must be perfect. Not only must the pyogenic cocci be killed, but the spores of the most resistant bacteria, whether pathogenic or not, must likewise be destroyed by the sterilizing process. It is not sufficient to have a method which apparently gives good clinical results. In the literature of the subject we find many methods which have been extensively used and the results clinically declared good, which careful bacteriological tests prove to be untrustworthy. The reason of the discrepancy is probably the following: The method of sterilization destroys the least resistant bacteria and inhibits to a certain extent the growth and development of the more resistant. When such catgut is placed in tissue which is well supplied with blood the bacteria and their spores in their weakened condition are destroyed by the tissue juices, leucocytes, etc. Place such catgut, however, in conditions which favor the development of these bacteria, as in a large blood-clot or in tissue cut off from its blood supply, and we may easily conceive of a very different result. The bacteria or their spores finding here conditions favoring their development and multiplication may grow as on the common nutrient media in the laboratory and having acquired sufficient powers of resistance may invade the human organism. Bacteria which are considered non-pathogenic may cause the decomposition of such a clot and the absorption of the products so formed may act to the detriment of the patient.

In my experiments I have seen the spores so acted upon that only after several days would they slowly develop into bacteria when placed in *bouillon* at a favorable temperature. Placed immediately upon nutrient agar or gelatin they would not grow, but after their development in *bouillon*, when transplanted to these media, they would grow readily. The conscientious surgeon would not to-day use any suture material which is not certainly sterile.

The second essential condition is that the catgut must be strong and pliable. After fulfilling these essential conditions the ideal method of sterilization should fulfil others, viz., the method should not require too much time nor be too troublesome, the catgut should not be swollen, it should be kept in some manner where it is not easily contaminated, it should be easily transportable, and it should be free from poisonous or irritating chemical substances.

The various methods in use depend upon heat, chemical agents, or a combination of the two as a means of sterilization. Heat is an ideal method of sterilization so far as the destruction of the bacteria is concerned. A sufficiently high temperature will destroy all bacteria known to us and leave no extraneous irritating substances in the material sterilized. The problem is the method of applying the heat so as not to impair too much the strength and pliability of the catgut.

It has been found that catgut, which has been thoroughly dried, will stand a high degree of heat without much injury. Upon this principle depends the "Dry Heat" and the "Cumol" methods of sterilizations. Chemical agents, on the other hand, are uncertain in their bactericidal properties and investigators are becoming daily more sceptical as to these properties. Soak contaminated silk or catgut in a carbolic acid or mercuric chloride solution and place these material on nutrient media without washing out or neutralizing these chemical agents and enough of the carbolic acid or mercuric chloride may remain in the strands of silk or catgut to prevent the development of the bacteria. Neutralize or wash out thoroughly the chemical agents and the microorganisms will grow. Upon this depends the apparently favorable bacteriological tests of many untrustworthy methods. Reppert first called attention to this. The agent used also remains in the catgut and may do harm where much of the material is used.

In looking over the methods of catgut sterilization in more general use the following ones suggested themselves as the most promising: Schäffer's, Vollmer's (Formalin), Reverdin's (Dry Heat), Krönig's (Cumol), Sweetnam's.

I will give a short description of each and my tests bacteriologically in a tabulated form.

Schäffer's Method.—This method, which is one of the simplest in its technique, is as follows: The catgut without previous preparation is boiled in the following solution: absolute alcohol, 85 ccm.; distilled water, 15 ccm.; pure mercuric chloride, .5 grm. At least 250 ccm of this solution is placed in an apparatus devised by Schäffer along with the catgut and by means of a water bath brought slowly to the boiling point of the liquid. After 15 minutes vigorous ebullition the alcoholic solution is allowed to cool 5-10 minutes, the catgut is removed and placed in 95 per cent alcohol, and it is ready for use. Schäffer says in his article in conclusion, that the catgut is absolutely sterile, that it loses none of its strength, that the sterilization takes only 30-40 minutes, and that the apparatus cost only 15 marks. He has written an exhaustive article upon the subject of catgut sterilization and in it reviews many other methods, all of which he regards as faulty. I gave his method a thorough bacteriological test, using the utmost care in carrying out his directions. It is necessary to render the mercuric chloride remaining in the catgut after sterilization inert as regards its action upon the bacteria used. To do this I introduced the ligatures into test tubes containing sterile water, and conducted into this through a sterile glass tube the gas obtained by heating ammonium sulphide. The mercury remaining in the ligatures was precipitated as a sulphide which is inert in its action on bacteria. This was afterwards washed out in sterile water and the ligatures were finally placed in *bouillon* tubes and these put in the laboratory incubator. The table which follows shows the results obtained. I will briefly state here the method used by me in obtaining resistant spores. The bacteria used were obtained from the Bacteriological Laboratory of the Johns Hopkins Hospital through the kindness of Dr. Harris.

I chose the following bacteria, *i. e.* Bacillus Anthracis, Bacillus Subtilis, Bacillus Megatherium and a resistant Potato Bacillus. The latter was one which grew on some of my potatoes after the usual sterilization. These bacteria were placed upon slant-agar and potato and allowed to grow for three or more days at a temperature 28°-30° C. Coarse silk threads, which were used in the tests as more convenient than catgut, were rubbed thoroughly into the cultures which invariably contained numerous spores and were then subjected to the sterilizing processes. After neutralizing or washing out the chemical ingredients used in the various methods the sutures were dropped into bouillon tubes and these were placed in the incubator. In most of my experiments no effort was made to keep the bacteria apart and in some cases I was satisfied to obtain a growth which contained at least one of the bacteria used. However, as shown in the tables, I did in some cases use pure cultures of the bacteria. This can be seen by referring to the tables where the microorganisms are indicated by the first letter of their names, as A—Anthrax, S—Subtilis, P—Potato Bacillus and M—Megatherium. A glance at the following table will show that in every trial of the method a growth was obtained from the sutures which had been subjected to Schäffer's sterilizing process. In four tests, where I used anthrax alone, this microorganism was obtained in pure culture. The method must in consequence of these results be regarded as thoroughly unreliable. Anthrax in catgut has caused in more than one reported case a fatal infection. Within the past six months a Chicago surgeon has told me of two of his patients who were operated upon the same day, dying of anthrax infection which was caused by the catgut used in the operations.

SCHÄFFER'S METHOD.

Date.	Bacteria.	Result.
April 12th..	A. S. P. M.	Growth.
" 19th..	"	Growth. (Anthrax and subtilis isolated.)
" 24th..	"	Growth.
" 27th..	"	"
" 28th..	"	" (Anthrax and subtilis isolated.)
May 4th..	"	"
" 15th..	A.	" (Pure culture of anthrax.)
" 24th..	A.	" (Pure culture of anthrax. Animal inoculation.)
" 26th..	A.	" (Pure culture of anthrax. Animal inoculation.)
June 11th..	A.	" (Pure culture of anthrax. Animal inoculation.)

Kossmann's Method.—Kossmann takes ordinary catgut and immerses it in a 2 per cent formaldehyde solution for 24 hours. It is then washed two or three times in Tavel's solution: Sod. Chlor., 7.5 parts; Sod. Carbon., 2.5 parts; Dist. water, 1000 parts; with gentle shaking to remove the formaldehyde. The catgut is kept in the same solution. He claims that the catgut is sterile, strong, and swells very little. Schäffer tested this method repeatedly and asserts as a result of his experiments that the catgut is not certainly sterile. The method has so much to recommend it in its simplicity that I

tested it thoroughly. The catgut loses considerably in strength, swells to a certain extent and my bacteriological tests, while at times negative, showed enough positive results to prove that one cannot recommend the method. Schäffer made the assertion that the reason that Kossmann and Vollmer, who recommended the method, got negative results when testing the method bacteriologically was because they did not neutralize the formalin, and enough of this remained in the threads to inhibit the growth of the bacteria or the development of the spores. He took some sutures, which had been inoculated with resistant bacteria, subjected them to the action of formalin and placed them without this neutralization in bouillon. They remained in this media eight days without the development of the bacteria. He then neutralized the formalin with dilute ammonia and the bacteria readily developed. In the experiments given in the following table the formalin remaining in the sutures was neutralized by means of ammonia gas driven off by heating aqua ammonia and conducted into the test tube through a sterile bent glass tube.

KOSSMANN'S METHOD.

Date.	% Formaldehyde.	Time exposed to formalin.	Bacteria.	Result.
April 14th...	2%	24 hours.	A. S. M. P.	Negative.
" 19th...	2%	24 "	"	Negative.
" 20th...	2%	24 "	"	Growth.
" 25th...	2%	24 "	"	"
" 28th...	2%	24 "	"	"
May 1st...	{ 2% 4%	{ 24 " 24 "	"	"
" 3rd...	{ 2% 4%	{ 24 " 24 "	"	Negative.
" 16th...	{ 2% 4%	{ 24 " 24 "	"	Growth.
" 22nd...	{ 2% 4%	{ 24 " 24 "	"	Negative.
" 16th...	{ 2% 4%	{ 24 " 24 "	A. S.	{ Negative. "
" 22nd...	{ 2% 4%	{ 24 " 24 "	A. S.	{ " "
June 9th...	4%	24 "	A. S. M.	"
" 12th...	{ 2% 4%	{ 24 " 24 "	A. S.	{ Growth. Negative.
" 19th...	{ 2% 4%	{ 24 " 24 "	A. S. M.	{ Growth. Negative.
" 21st...	2%	24 "	A.	Negative.
" 23rd...	2%	24 "	A. S. M.	Growth.
" 26th...	2%	24 "	"	"
" 29th...	2%	24 "	"	Negative.
July 7th...	2%	24 "	"	"

I tried, in addition to the above experiments, dipping the threads in oil after inoculation and before sterilization, and in every instance got positive results. This was to be expected as the oil prevented the formalin from coming in contact with the bacteria. It is an additional objection to Kossmann's method. As a result of my experiments the sterilization of catgut by this method I regard as untrustworthy and therefore should not be employed.

Sweetnam's Method.—Sweetnam's method consists in heating the catgut in sweet almond oil containing 10 per cent of carbolic acid over a water bath at a temperature of 212° F. for one hour, and preserving the catgut in the same solution. The method has much to recommend it in its simplicity and the short time required in carrying it out. I give the table of tests below. One will notice that some of the tests gave

positive results, and if I could have found some means of neutralizing all of the carbolic acid or freeing the threads from the carbolized oil there would undoubtedly have been more. Attempts to wash the oil which contained the carbolic acid from the silk were to a large extent futile, and a sufficient quantity of the antiseptic probably remained in every instance to inhibit to a certain extent the development of the spores. Leaving this out of consideration a sufficient number of positive results were obtained to make us regard the method as unreliable.

SWEETNAM'S METHOD.

Date. 1899.	Bacteria.	Treatment to rid threads of carbolized oil.	Results.
June 10th..	A. S. M.	3 rinsings in sterile water.	Negative.
" 13th..	"	4 " " "	Growth.
" 14th..	"	4 " " "	Negative.
" 22nd..	"	Allowed to stand 24 hours in sterile water; rinsing.	Growth.
" 26th..	"	24 hrs. in water, and 3 rinsings.	Growth.
" 28th..	"	24 " " " "	Negative.
July 5th..	P. A. S. M.	1 rinsing in NH_4O -3 in sterile water.	Growth.
" 6th..	"	2 rinsings in NH_4O and 1 in sterile water.	Negative.
" 8th..	"	2 rinsings in NH_4O and 3 in sterile water.	Negative.

I did not make as many tests of this method as of the others because I could not find a satisfactory method of freeing the sutures from the oil.

The Dry Heat Method.—This method was originated by Reverdin and used subsequently by Döderlein, Benckiser, Boeckmann and others. It consists in heating the catgut slowly in a dry air sterilizer to 150°C ., and keeping it at this temperature for 2 hours. I found it very difficult with an ordinary laboratory sterilizer to regulate the heat, and the catgut was apt to lose its strength. Schäffer had no criticism to offer so far as the bacteriological provings were concerned, and my experiments, as can be seen in the table, were satisfactory. The catgut was not as strong and pliable as the Cumol catgut and the method requires closer attention unless one has a better method of regulating the heat than can be had with an ordinary dry air sterilizer. The following table shows the time of drying and the temperature at which the sutures were heated:

THE DRY AIR METHOD.

Date. 1899.	Time of drying.	Time of heating.	Bacteria.	Results.
July 3	3 hrs. to 140°C .	$\frac{1}{2}$ hr. at 140°C .	A. S. P. M.	Growth.
July 5 2 exp.	$1\frac{1}{2}$ hrs. to 140°	$\frac{1}{2}$ hr. at 140°	"	"
July 6 2 exp.	$1\frac{1}{2}$ hrs. to 140°	1 hr. at 138° - 142°	"	Both negative.
July 8 2 exp.	$1\frac{1}{2}$ hrs. to 140°	1 hr. at 138° - 140°	"	Growth in both.
July 7 2 exp.	$\frac{1}{2}$ hr. to 140°	50 mins. at 140°	"	" "
July 10 2 exp.	2 hrs. to 140°	1 hr. at 138° - 143°	"	" "
July 12 2 exp.	3 hrs. to 140°	5 hrs. at 138° - 140°	"	Both negative.
July 13 2 exp.	$2\frac{1}{2}$ hrs. to 140°	$1\frac{1}{2}$ hrs. to 138° - 147°	"	" "
July 14 2 exp.	3 hrs. to 140°	4 hrs. to 140°	"	" "
July 17 2 exp.	2 hrs. to 140°	$1\frac{1}{2}$ hrs. at 135° - 150°	"	" "
July 21 2 exp.	1 hr. to 140°	2 hrs. at 140° - 145°	"	Growth in one.
July 22 2 exp.	2 hrs. to 140°	$2\frac{1}{2}$ hrs. at 140° - 142°	"	Both negative.

One sees that in the above experiments in almost every case where the threads were heated for 2 or more hours at a temperature above 140°C . the threads remained sterile. Reverdin's method calls for 2 hours at 150°C . The method must therefore be regarded as satisfactory from a bacteriological standpoint.

The Cumol Method.—The Cumol method of catgut sterilization first used by Krönig and modified by Clark and Mille proved to be perfect as regards its germicidal properties, and when properly carried out gave strong, pliable catgut. I give here an account of the method as used in the Johns Hopkins Hospital and append a table of bacteriological provings: "Cut the catgut into desirable lengths, 35-40 cm., wind it into small coils or rolls each containing eight to ten strands (It should not be tied or only loosely). It is then heated slowly (at least two hours) to 85°C . in a dry air sterilizer and kept at this temperature approximately for two hours. After thorough drying it is placed immediately in a metal vessel containing Cumol (which should cover the catgut), and this is heated over a sand bath to 160 - 165°C . and kept at this temperature for one hour. The Cumol is then decanted and the excess left in the catgut is evaporated by leaving the vessel over the sand bath for one hour longer, the flame having been removed. The rolls of catgut are then placed in wide mouthed sterile test tubes, a few rolls in each tube, and these are kept in a covered vessel and used as desired. A convenient apparatus has been devised by Clark which could be improved by leaving off the glass indicating tube. The principal points to be observed are as follows: the catgut must be perfectly dried before subjecting it to the high temperature of boiling Cumol, and care must be taken that the vapor of the Cumol, which is heavier than air, does not come into contact with the flame or red hot metal. If the catgut is not perfectly dried it will become brittle on boiling. To prevent the Cumol from taking fire the sand bath must be a wide one extending at least 3-4 inches beyond the flame on all sides and the vessel containing the Cumol should have a tightly fitting top with a corked opening for the thermometer, and an escape tube, by means of which the gaseous Cumol can be conducted away from the flame. Any device by which the vapor is prevented from rolling over the sides of the vessel will answer. It is well to place the catgut before drying in a suitable wire basket and surround it with filter paper. The basket with its contents is transferred from the drying apparatus to the Cumol. This device prevents the catgut from coming in contact with the sides of the metal vessel. The method of Cumol sterilization has been used for five years in the Gynecological Department of the Johns Hopkins Hospital with perfectly satisfactory clinical results. The objections to its use are the time and care required in carrying it out. The cost is relatively small, as very little Cumol is lost each time and the liquid can be used repeatedly."

The No. 3 catgut, the heaviest used by us, is completely absorbed in the skin in ten days and loses largely its strength in 6-7 days. For ordinary purposes this time is sufficiently

long, but in the closure of hernia, abdominal incisions, etc., a longer time of absorption is desired. I have taken advantage of the well known fact that catgut soaked in formalin requires a longer time for absorption to overcome this objection. The No. 3 catgut is soaked in a 4 per cent formaldehyde or a 10 per cent formalin solution for ten hours; it is then washed several hours in running water, dried, and sterilized by the Cumol method. Catgut so treated is as strong as ordinary catgut and rougher on its surface, which is no objection in tying. I have tested the time required for its absorption in a large number of cases during the past eight months and find it to be from 14-18 days. By using stronger solutions of formalin or by exposing the catgut longer to its action this time can be increased. If soaked too long or if the formalin is not thoroughly washed out the catgut loses in strength. My method is, to take the large rolls of catgut as they come from the dealer, cut the silk threads which bind them, place them on a cylinder which they fit loosely, and soak them in the formalin. After ten hours they are removed from the formalin and placed in running water overnight. They are then wound on a loose, wide gauze roller bandage and dried in the sun or before a hot air draught. The process after that is the same as described in the Cumol method.

The following table shows how absolute the sterilization

is in the "Cumol Method." The method calls for one hour at the required temperature, while in every instance in ten minutes the same bacteria which were used in the other experiments were completely destroyed. Until some simpler method is discovered which gives equally as good bacteriological results the "Cumol Method" is the one to be recommended. All methods which depend upon chemical agents must be looked upon in a critical manner. Numerous ones are in every day use which a careful bacteriological test would condemn, and no surgeon should accept any method of sterilization, however much it has to recommend it in its simplicity, unless it is above criticism from a bacteriological standpoint.

Date. 1899.	Bacteria.	Time of sterilization.	Results.
May 24th.....	A. S. M.	30 mins.	Sterile.
" 25th.....	"	30 "	"
" 26th.....	"	30 "	"
" 27th.....	"	25 "	"
June 1st.....	"	15 "	"
" 9th.....	"	25 "	"
" 12th.....	"	20 "	"
" 20th.....	"	15 "	"
" 22nd.....	"	10 "	"
" 23rd.....	"	10 "	"
July 15th.....	"	10 "	"
" 20th.....	"	10 "	"

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ON THE ETIOLOGY OF TROPICAL DYSENTERY.¹

By SIMON FLEXNER, M. D.,

Professor of Pathology, University of Pennsylvania.

There are few subjects in medicine that have attracted more attention than dysentery. Its history dates from the earliest written records and its ravages, unlike those of many of the venereal diseases, have continued practically unaltered to the present day. The most ancient writing upon medicine—the papyrus Ebers—contains allusions to dysentery; the oldest Greek medical writers refer to it under the name “Atisar,” and Herodotus speaks of its prevalence in Thessaly. Hippocrates, however, was the first to regard dysentery as an independent disease. I should hesitate to bring before this audience a subject so time-worn were it not for the fact that the etiology and more especially the etiology of dysentery are among the problems that still await a satisfactory solution. Although destructive epidemics which characterized the appearance of the disease in ancient times, and which were not unknown as late as the last century, are in our own day encountered only as accompaniments of war and famine; nevertheless dysentery still occurs in epidemic form in many Eastern and Western countries, while in the tropics the disease—not like cholera, another infectious disorder, the characteristic lesions of which are situated in the intestines—would seem to have found an endemic home.

Our imperfect knowledge of the nature of dysentery should be ascribed neither to lack of opportunity for the study of the disease nor to lack of energy in its pursuit. The literature contains some of the most distinguished names among clinicians and investigators, thanks to whose efforts its clinical history, its epidemiology, and, to a less extent, its pathological anatomy have received partial elucidation. Nor has the disease, in the past quarter of a century, escaped the attention of the bacteriologists, although it must be confessed that the results of somewhat extensive studies along these lines have been far less conclusive than might have been expected. Given a disease that is never entirely absent from temperate and tropical regions, that appears with epidemic severity, that permits of easy access to the *materies morbi*, one would certainly have been tempted to predict that the success achieved in so many other and apparently no less difficult fields, would probably be repeated. That the attempt to establish a common etiological factor for all cases of dysentery has thus far failed, this audience need not be reminded. That this failure has tended to emphasize the existence of several pathological states, for which the term dysentery is employed merely as the collective designation, need not be maintained here. But that these conclusions regarding the disease may after all not be in keeping with the facts is at least open to suspicion. When we recall the protean nature of other infectious diseases,

¹ Middleton-Goldsmith Lecture. Delivered before the New York Biological Society, April 12, 1900.

among the most common of which are tuberculosis and typhoid fever, there can be no *a priori* objection to the hypothesis that the causative agent of dysentery need not necessarily vary for each of the many types of the disease that have, from time to time, been distinguished.

For the purpose of my inquiry, I shall consider briefly the clinical and pathological types, after which I shall ask your attention to the evidence for belief in specific causes. In considering this topic I shall endeavor to bring out the bearing of such studies upon dysentery in general and upon particular types of the disease. Finally, I shall hope to emphasize certain considerations connected with the etiology and pathology of dysentery by reciting some observations made upon the dysenteries prevailing in the Philippine Islands.

Types of Dysentery.—That the lines of demarcation between the several clinical and pathological types should be inaccurate is not a matter of wonder. Both the beginning and end of any given instance may vary widely, and the symptoms and lesions of cases arising sporadically in temperate climates may agree with those of dysentery occurring endemically in the tropics or epidemically in both localities. The terms "catarrhal," "tropical," "epidemic," and "diphtheritic," are far from signifying sharply-defined entities. The clinical manifestations and pathological lesions of the catarrhal variety occur in all kinds of dysentery and in all places where the disease prevails. Ever since the time of John Hunter there have been those who, upon pathological-anatomical grounds, have separated the endemic from the epidemic disease, and the line has been even more sharply drawn during the past decade, since the discovery of the *Ameba coli* in its relations to tropical dysentery. But the distinction between tropical dysentery and the epidemic disease is far from being sharp and constant. Diphtheritis and ulceration are not safe criteria. For while the former is commonly present in the epidemic disease, it occurs also in the tropical malady, and may, according to Kartulis, be associated with the ulcerative amebic variety, in which the lesions begin with destruction of the submucous coat of the gut.

As must always occur when classification of a disease proceeds upon clinical and pathological rather than etiological lines, the literature of dysentery is burdened with an interminable mass of appellations indicating the nature of the disorder or the author's conception of its pathological anatomy. Dysenteries, however, are now divided by the chief writers into several groups, depending upon the clinical history or the mode of prevalence. Thus Osler writes of 4 varieties, the acute catarrhal, the tropical or amebic, the diphtheritic, and the chronic dysentery. Davidson considers the subject under 2 headings: (1) according to prevalence—epidemic, endemic, the dysentery of war and famine; (2) upon clinical grounds—acute fibrinous or pseudodiphtheritic, and chronic dysentery. Kartulis describes endemic, epidemic and sporadic varieties; Manson speaks of a catarrhal and ulcerating dysentery, while Delafield distinguishes in the environs of New York at least 5 distinct types of this disease, only one of which would appear to be due to a specific agent—the *Ameba coli*.

Evidences for Specific Causes. Bacteria.—The presence of bacteria in the stools and tissues in dysentery was demonstrated by Klebs, Prior and Ziegler, whose studies, carried on upon the epidemic disease, have now only a minor historical interest, although Ziegler still holds that the relations of certain bacilli to the lesions speak for their pathogenic action. The early studies of Hlava upon the epidemic disease yielded quite inconclusive results, since, although he was able to obtain as many as 19 different kinds of bacilli in culture, inoculations into animals failed entirely to reproduce the morbid process. Chantemesse and Widal were somewhat more fortunate. From five cases of tropical dysentery they obtained a bacillus which, when injected into the stomach and rectum of guinea-pigs, gave rise to diphtheritis, an observation which Grigoriew, who believed that he had isolated the same microorganism from 10 cases of dysentery, failed to confirm.

Maggiori, who studied 11 cases of the epidemic disease, obtained *B. coli communis* regularly and in large numbers. Less frequently *B. proteus vulgaris* was isolated, while in some cases the pyogenic cocci and *B. pyocyaneus* were found. This investigator considered it highly probable that the disease was caused by a *Bacillus coli* of intensified virulence—a conception also shared by Laveran, Arnaud, Celli and Fiocca and Escherich, who isolated the same organisms from dysenteric cases. Arnaud's series was larger, embracing 53 acute cases occurring in Tunis, from all of which *B. coli* was isolated. The spleen of a fatal case also yielded him the organisms. The ingestion of cultures in the case of several kinds of animals gave no results; while rectal injections of bouillon cultures, previously raised to 60-80° C., produced in two dogs a fatal and characteristic dysentery—a result in striking opposition to those reported by other writers.

The studies upon this bacillus by Celli and Fiocca are the most important which we possess. Their cases numbered 62 and included examples of the sporadic, epidemic, and tropical disease occurring in Italy and Egypt. From the fact that especial attention was paid to the occurrence and action of the *Ameba coli*, the results of these authors are doubly useful. They exclude this organism as the cause of any form of the disease and consider that a variety of the colon-bacillus, of especial virulence, which they designate *B. coli dysenteriae*, is responsible for the lesions. Along with this colon-bacillus they found typhoid-like bacilli and streptococci. Their experiments upon animals are also more conclusive than others. With cultures they were able to produce dysentery in cats, and while they admit that other microorganisms were also capable of producing similar results, they found that the latter acted far less constantly than their dysenteric bacillus. A toxin separated from growths of the organism was found to give rise to similar conditions. Celli, in another publication, expresses the view that it is this toxin that first exerts an injurious effect upon the intestinal mucosa, after which the destructive lesion is produced by the pyogenic cocci. Results similar to those of Celli were obtained by Del Pino and Alessandri. The latter, working on a case of postoperative dysentery, secured cultures of *B. coli* that yielded a toxin.

capable of setting up dysentery in young cats. In their most recent paper, Celli and Valenti describe the production in dogs of sera, which, when tested upon experimental animals, exert a protective and healing effect. Upon human beings the action was not equally positive.

The colon bacillus is also believed by Escherich to play an important part in the production of a contagious enteric disorder (colitis contagiosa) in children. In its morbid anatomy the disease agrees with catarrhal dysentery.

The bacilli thus far enumerated, except those of Chantemesse and Widal, so far as they could be studied in cultures, have shown no specific properties. They all represent a well-known bacterial species, constantly present normally in the situation from which the organisms were obtained in disease, and whose only unusual properties were increased virulence when tested upon animals, and a capacity to set up enteritis when injected into the intestines of dogs and cats.

The investigations of an epidemic of dysentery which prevailed in Japan yielded different and apparently more convincing results. Ogata isolated fine bacilli, which liquefy in gelatin, stain by Gram's method, and set up, when introduced by the mouth or by the rectum into guinea-pigs and dogs, intestinal ulcerations. The organism regarded by Ogata as the cause of epidemic dysentery was isolated from 23 cases of the disease occurring in Padua by Vivaldi. Since that time it appears not to have been found again.

This list does not entirely cover the bacillary species isolated from cases of dysentery. The recent publication of Ogata, who also studied the disease prevailing in Japan, is needed to complete the number. But as this investigator's studies have a very direct bearing upon my own, I shall defer speaking of them for the present.

On the other hand, a causative rôle in the production of dysentery has also been ascribed to the pyogenic cocci. Bacteria being found in association with bacilli, by several of the investigators already mentioned, they have been regarded as the chief pathogenic agents by Zancanol, whose studies were carried out in Alexandria, by Silvestri of Turin, by Bertrand and Baucher of France, and very recently by Ascher. He investigated cases arising in Eastern and Western Prussia. These cocci, especially the streptococci, were capable in certain instances (Silvestri, Ascher) of setting up, in cats, dysentery, and liver-abscess. The cocci isolated by Ascher were also said to have shown the agglutination reaction with the blood-serum of the patients from whom they were obtained. As a cause of a special variety of endemic dysentery, the endemic enterocolitis of Cochin China—Calmette obtained the *Bacillus pyocyaneus*. The same microorganism was isolated, from a small epidemic of the disease occurring in New York State, by Lartigau, in another epidemic in children, prevailing in Canada, by Adami, and in certain sporadic cases of gastric and enteric infection, by L. F. Barker in Baltimore.

Protozoa.—Because of the great diversity of the normal intestinal flora the varieties of bacteria which can be isolated from the dejections and intestinal contents are relatively

numerous. The differences in the numbers and kinds of bacteria capable of flourishing there, rendered possible by the existence of pathological conditions, readily account for many of the results of the bacteriologic studies given. With animal microparasites the case is different. Protozoa do not exist in easily demonstrable forms or numbers in the dejecta in health, and the number of species occurring under all conditions is small. Of these the list is confined to a few kinds of flagellates—which even when present in considerable numbers do little harm—and the amebæ.

It is to the rôle of the amebæ—a particular variety of which has achieved the distinction of being connected in a causal relation with endemic dysentery—that I wish to direct your attention. Since the studies of Kartulis, Councilman and Lafleur, and Kruse and Pasquale, so firmly has the idea of this connection taken hold of the popular medical mind, that the designation “amebic” as synonymous with “endemic” or “tropical” dysentery has been widely adopted. And yet the evidence upon which this belief is based cannot be regarded as convincing. Until we shall have gained means of differentiating amebæ other than those we now possess, and, moreover, until we are able to control their development with at least as great perfection as in the case of bacteria, the question of the precise part played by them in dysentery cannot be satisfactorily determined.

Since the historical observation of Lambl upon the occurrence of amebæ in the dejections of human beings, and especially since the confirmatory observations of Cunningham, Lewis and R. Koch, our knowledge of the distribution of these organisms in human beings has constantly widened and deepened. It was, moreover, the study by Lösch of a case of dysentery in which an ameba, called by him *Ameba coli*, occurred that gave the impulse to the investigation of the pathological actions of such organisms.

The importance of amebæ was further enforced by the demonstration of the organisms in sections of dysenteric ulcers by R. Koch, first in Egypt and afterwards in India. Following these successes, and probably directly through the suggestion of Koch, Kartulis began his series of observations and publications, which more than any other similar writings have tended to isolate tropical dysentery and place it upon a probable etiologic basis.

The work of Kartulis need not be reviewed in detail in this place. His conclusion that in every undoubted case of dysentery occurring in Egypt the amebæ are present, has not been entirely confirmed. That they are, moreover, never present in the intestines in other enteric diseases and in health has also not been the experience of all other investigators. But that amebæ are abundant in many cases of tropical dysentery and may also be demonstrated in the contents of the hepatic abscess in the disease, the studies of Kartulis and those of subsequent investigators have definitely shown.

To follow the list of discoveries in cases of dysentery which have accumulated in the last decade is unnecessary and would carry us too far afield. Reports confirmatory of the results of Koch and Kartulis have appeared from many European

countries, the Pacific Islands, and from both North and South America. Ten years have, however, seen a modification of the views regarding amebæ, as causes of pathological conditions in human beings. The demonstration of amebæ, indistinguishable from the *Ameba coli*, in various intestinal diseases and even in healthy persons, has necessitated a recasting of the exclusive belief in their pathogenicity and relation to dysentery.

That amebæ may exist in diseases other than dysentery was conclusively proven by the early observations (Cunningham, Lewis) upon choleraic discharges. More important results were obtained by Grassi, first in 1882 and later in 1888. He describes amebæ which may occur, in considerable numbers, in diseases as varied as typhoid fever, cholera, pellagra, and colitis secondary to tumors. He demonstrated their presence in diarrheas and dysenteries, but at times also found them in the dejecta of healthy individuals. That amebæ can exist in the intestines without any disturbance of the health of their host was, therefore, definitely established by Grassi's observations as well as by those of Calandrucci, Massiutin, Kruse and Pasquale, Gasser and Schuberg. The observations of the last-named investigator are especially valuable, in that he showed that to the reaction of the lower colon and the consistence of the feces was due the fact that amebæ could not be constantly found with comparative ease in the dejecta. If a laxative, as for example, Carlsbad salts, is administered and the contents of the upper colon are then collected and examined, amebæ are frequently demonstrable. Moreover, under these conditions flagellates—the trichomonas and cercomonas—appear in the stools. He looks upon these parasites as common commensals in man.

It can, therefore, no longer be held that amebæ are necessarily pathogenic when found sojourning in the intestine in man. Indeed, the necessity of recognizing distinct species of amebæ had already begun to force itself upon thoughtful students, who until lately believed in their constant pathogenic action. Quinke and Roos, who observed amebæ first in a healthy individual, and later in two widely dissimilar cases of enteritis, tested the different organisms concerned for pathogenesis upon cats. From their results they believed that according to certain structural differences, and the action of the parasites in engulfing red blood-corpuscles, two main varieties or species can be distinguished, the one phagocytic for red blood-corpuscles and pathogenic for man and cats—this species being identical with the *Ameba coli* of Lösch—the other, nonpathogenic and nonphagocytic for blood-corpuscles, which they designate *A. coli mitis*. According to this view *A. coli*, *A. felis*, and *A. dysenteriae* of Councilman and Lafleur are all one species; *A. coli mitis* a harmless saprophyte, or at least is one of relative pathogenic insignificance.

It requires no elaborate argument to bring out the fallacies of such a method of distinction. Results following the introduction of so complex a material as dejecta into an animal cannot be accepted as deciding the properties of any single constituent. What has already been said concerning the ability of pure bacterial cultures to produce enteric lesions affords a sufficient criticism of such a procedure.

That amebæ when combined with bacteria may cause intestinal lesions and even ulceration is now established. Furthermore, the experiments of Kartulis and Kruse and Pasquale with the contents of hepatic abscesses, supposed to be free from bacteria, are all but convincing, in so far as they may be supposed to prove the capacity of amebæ alone to set up such changes.

The attempt to cultivate the *Ameba coli* without admixture of bacteria has in all probability never yet been successfully carried out. The supposed positive experiment of Kartulis is now known to have been erroneous. Whether Celli and Fiocca have succeeded is still doubtful. In any case no satisfactory experimental production of amebic dysentery in cat or other animals has thus far been achieved with cultures of amebæ free or relatively free from bacteria.

The pathological findings in amebic dysentery have been adduced as proving its specific character by Councilman and Lafleur, Kruse and Pasquale and Kartulis. According to this view the intestinal ulcers in amebic dysentery begin as an infiltration of the submucous coat that leads to necrosis of the overlying membrane. The lesions, unless complicated by the presence of bacteria, are free from the products of purulent inflammation. The accompanying abscess of the liver exists independently of the presence of bacteria. Kruse and Pasquale, and Kartulis ascribe greater significance to bacterial association than do Councilman and Lafleur. Kartulis sees in the occasional diphtheritis evidence of their action, while Kruse and Pasquale have followed them in their penetration into the coats of the gut, where they lie side by side with the amebæ or even precede them in the invasion. Both bacilli and cocci occur; and wherever necrosis is found, bacilli are sure to occur in groups and masses. "The amebæ and bacilli together start the lesions in the intestine." (Kruse and Pasquale.)

The form of lesions here described does not entirely represent the disease as it appears in the tropics. Even Lafleur in a later communication says that the term "tropical" can be used only as a partial synonym for amebic dysentery, inasmuch as, on the other hand, the disease, though more frequent in the tropics, is by no means limited to those regions, while on the other hand, there are undoubted cases of dysentery in the tropics which are not of the amebic form—a statement borne out by my own observations.

How far, then, have the foregoing results aided us in clearing up the hitherto obscure etiology of this protean malady? While epidemic, endemic, and sporadic dysentery have been subjected to bacteriological investigation, the chief work thus far done has been with the tropical variety. Although the actual number of cases of the epidemic disease which have been carefully studied is small, it is significant that, with two exceptions—the studies of Ogata and Calmette—the several different microorganisms isolated have all been bacteria which are normally present in the intestinal canal. The cultures have, it is true, undergone changes of virulence, but in other respects they have retained their ordinary biological and physiological properties unaltered. It would certainly seem *a priori* highly improbable that so severe and devastating

disease as epidemic dysentery should be due to microorganisms which are constant inhabitants of the intestinal tract. Moreover, when it is recalled how easily and under what great variety of conditions such accessions of virulence may be achieved, it would be remarkable that epidemics of dysentery are, nevertheless, relatively rare phenomena.

Turning to the tropical disease, we also observe that several microorganisms have been assigned as the causative agent. Chantemesse and Widal have described a bacillus not obtained since from similar cases; Arnaud, Laveran, and Celli and Fiocca have seen in the colon-bacillus, modified in its pathogenicity, a sufficient cause. More weight, and with far greater justice, has been laid upon the *Ameba coli*. But this organism has been found more especially in chronic cases. Kartulis states that the catarrhal stage, which is common in the epidemic and sporadic disease, is uncommon in this form. If the *Ameba coli* is the organism most commonly present in the acute dysenteries of the tropics, the fact has not yet been conclusively established. However this may be, in Manila, where the organism is not infrequently present in the chronic disease, its absence in the very acute and often rapidly fatal cases of dysentery must be regarded as of significance.

From the preceding considerations the following conclusions seem warranted:

1. No bacterial species yet described as the cause of dysentery has an especial claim to be regarded as the chief microorganism concerned in the causation of the disease.
2. It is unlikely that any bacterial species that is constantly and normally present in the intestine or in the environs of man, except where the disease prevails in an endemic form, can be regarded as the probable cause of epidemic dysentery.
3. The relations of sporadic to epidemic dysentery are so remote that it is improbable that the two diseases are produced by the same organic cause.
4. The pathogenic action of the *Ameba coli* in many cases of tropical, and in certain examples of sporadic, dysentery, has not been disproved by the discovery of amebæ in the normal intestine and in diseases other than dysentery. While amebæ are commonly present and are concerned in the production of the lesions in subacute and chronic dysentery, they have not thus far been shown to be equally connected with the acute dysenteries even in the tropics. In the former varieties, bacterial association probably has much influence upon the pathogenic powers of the amebæ.

THE DYSENTERY OF JAPAN AND THE PHILIPPINE ISLANDS.

Every year, especially in the summer and autumn, dysentery prevails in Japan. Ogata and Eldridge have given the statistics of incidence and mortality in the years from 1878 to 1899:

Year.	Cases.	Deaths.
1878.....	1,118	206
1879.....	8,322	1,487
1880.....	5,047	1,305
1881.....	7,001	1,837
1882.....	4,330	1,313
1883.....	21,172	5,066

Year.	Cases.	Deaths.
1884.....	22,702	6,036
1885.....	47,377	10,690
1886.....	24,328	6,839
1887.....	16,125	4,244
1888.....	26,789	6,570
1889.....	22,893	5,970
1890.....	42,632	8,706
1891.....	46,358	11,208
1892.....	70,842	16,814
1893.....	167,305	41,282
1894.....	155,140	38,094
1895.....	52,711	12,959
1896.....	85,876	22,356
1897.....	91,077	23,189
1898.....	90,933	22,379
1899.....	125,989	26,709
	1,136,067	275,289

The epidemic studied bacteriologically by Ogata occurred in the province of Oita where in 1890, 801 cases occurred with 221 deaths, and in 1891, 8390 cases with 2163 deaths—an average mortality of from 26 to 27 per cent. This epidemic had been preceded by sporadic cases in the previous winter, and in its spread showed a striking contagious character. The lesions in the intestine are described in one case, death having taken place on the eleventh day of the disease. The lower segment of the small intestine was hyperemic. The large intestine was greatly swollen so that the lumen was almost obliterated. The mucous membrane was hyperemic and presented a deep bluish-red color. The contents were chocolate-colored. The mucosa of the transverse and descending colon, and especially of the sigmoid flexure, showed small ulcers, the size of peas, which were so numerous as to give to the membrane a sieve-like appearance. They were also found, though in smaller numbers, in the descending colon and rectum. No large ulcers were present. The peculiar bacilli—staining by Gram, liquefying gelatine, and causing in animals, whether injected beneath the skin or into the rectum, hyperemia and ulceration of the intestinal mucosa—have been already described. Ogata's decision was that the bacillus isolated was probably the cause of the epidemic of dysentery prevailing in Southern Japan.

I am not acquainted with a full description of the morbid anatomy of the dysentery prevailing in Japan. Schaubé formerly of Tokio, in his "Die Krankheiten der warmen Länder," does not give a detailed account of the Japanese variety, but contents himself with the usual classification and description of the disease. The meager accounts may possibly be explained by the fact that necropsies are obtained in Japan only with great difficulty. Dr. Eldridge states that the lesions seen in "amebic dysentery" as described by Councilman and Lafleur are seldom met with. The common lesions are destructive, progressing from the surface downwards, associated with necrosis of the mucosa and croupous infiltration (diphtheritis). Perforation is unusual, the muscular coat offering a strong resistance to the pathological process.

The most recent bacteriological study of dysentery has been made by Shiga, to whose results I would ask especial attention. During 1897 the disease prevailed epidemically in Japan, 89,400 cases with 22,300 deaths (24 per cent) being recorded from June to December. Out of a considerable number of cases occurring in Tokyo, 36 were subjected to bacteriological examination by Shiga.

As was readily recognized by him, four points must be proved in the effort to show that an organism suspected of standing in etiological relation to any given disease is really the causative agent: (1) The organism must occur constantly; (2) it must be a species not present normally in the diseased part; (3) it must be pathogenic and produce in experimental animals lesions similar to those from which it was obtained; (4) it should in virtue of its pathogenic activity in man show the Widal agglutination reaction with the blood-sera of those who have suffered from the disease. From the series of cases examined there was obtained from the dejecta and intestinal contents and walls, and from the mesenteric glands, a bacillus which fulfilled all these requirements and which was regarded as the cause of Japanese dysentery, at least.

Before entering upon a description of this organism I should like to direct your attention to the dysentery prevailing in the Philippine Islands, especially in and around Manila. The report of the Surgeon-General of the Army for 1899 contains a tabulation of diseases, observed among the American troops, during the first four months of the American occupation of Manila. In it the dysenteries are included with the diarrheal diseases. The total number of cases reported is 445, the death-rate being 0.48 per cent. The comment made is that "the malarial diseases exceed their prevalence in the United States in the proportion of 370 to 96, and the diarrheal diseases in the proportion of 445 to 116, or about 4 to 1 in both instances."

This compilation fails to give an adequate idea of the extent, severity, and mortality of dysentery in Manila. Although, unfortunately, figures are not obtainable, I am convinced, after nearly three months' residence in Manila, that the enteric diseases, of which dysentery was the most frequent and important, were the chief causes of disability and mortality among the land forces of the American army.¹

The disease appears in two main forms, acute and chronic dysentery. The stools and intestinal contents at autopsy were scrutinized for amebæ. So far as regards the acute cases these organisms were absent or very difficult to find in the fresh stools and in the intestinal contents immediately after death. In the chronic forms of the disease ulcers were present in the mucosa and submucosa; the lesions were confined to the large intestine, the coats of which were greatly thickened; at times large sloughs of the mucous membrane, partly detached, were encountered. Amebæ were commonly

present, but were variable as to actual occurrence and numbers. Large hepatic abscesses, usually single, were encountered in a number of these cases. Amebæ were not always found in the contents of these abscesses; sometimes bacteria were present alone or associated with amebæ. Amebæ not distinguishable, except by the absence of specific inclusion from those in the stools of human cases exist in the dejecta of monkeys liberated from captivity and now at large in Manila.

The morbid anatomy of the chronic disease agrees in part only with that of "amebic" dysentery. I shall draw attention later to another form of the chronic disease.

The pathological changes in the acute cases differ widely from those of the chronic affections. I shall now give briefly the condition of the intestines in several cases of acute dysentery. The patients were American soldiers.

CASE 1.—Death on the sixth day of the disease. The entire large intestine from the cecum to the rectum is dilated and the walls of the gut are thickened. The mucous membrane swollen, its consistence is much increased and the normal folds are thrown into elevated, coarse corrugations. The general color of the mucous membrane is deep red, but there are present many brighter spots evidently due to hemorrhage. No distinct false membrane is to be made out, but here and there are scattered white elevations, which, after the intestine has been washed, become more prominent and can be removed only with some difficulty, small defects in the membrane being left behind. In the fresh state ulceration was not made out, but after the washing referred to, there are found in the lower portions of the sigmoid flexure minute, sieve-like points, with perfectly sharp edges, representing defects which lead into the submucosa. The smallest of these openings are the size of pin-points, the largest about 2 mm. in diameter. The contents of the intestine showed no amebæ.

CASE 2.—Death on the fifth day of illness. The small intestine, excepting the lower end of the ileum, which is deeply congested and swollen, shows no alteration. The serosa over the large intestine is injected, but is otherwise normal. The large intestine is much thickened and its consistence is increased. On opening the gut the contents are found to be dark or near black in color, an appearance probably due to the administration of bismuth. The mucous membrane extending from the rectum to the ileocecal valve, and beyond the valve in the ileum for a distance of 4 cm., is congested, swollen, and hemorrhagic. Scattered here and there on the surface are elevated, whitish, irregular points and small, flattened areas, which suggest pseudo-membrane, but which cannot be absolutely identified of such a nature. The normal velvety character of the mucous membrane is lost. No ulceration can be made out and the lesions seem to be chiefly in the mucosa and submucosa. Particularly conspicuous is the wide diffusion of the lesions, no part of the mucous surface within the limits defined having escaped. The mesenteric glands are congested and moderately swollen. Although amebæ had been found in the evacuations two days previous to death, they could not be demonstrated in the intestinal contents at autopsy.

CASE 3.—Death after an illness of 6 days. The large intestine is markedly dilated and the serous coat is much injected. The contents of the large intestine are represented by grumous, pink, pulpy material. The mucous membrane is swollen and hyperemic, and presents a striking granular appearance due to exudate upon the surface; many areas of hemorrhage are also observed. The entire mucosa of the large intestine

¹ The studies on dysentery here recorded were made by a commission consisting of Dr. L. F. Barker and myself, sent out by the Johns Hopkins University to study the diseases prevailing in the Philippine Islands. To this commission were attached Messrs. Joseph M. Flint and Frederick P. Gay, who were, at that time, members of the Johns Hopkins Medical School.

ne is implicated in this process. Ulceration is not present. The mesenteric glands are swollen, congested, and hemorrhagic. The spleen is moderately enlarged. Amebæ were not demonstrable in the intestinal contents.

The three cases which have been selected do not agree with amebic dysentery as hitherto described. In only one were amebæ found in the stools, and even then they could not be demonstrated in the intestinal contents, obtained immediately after death, which took place two days after the first examination. The stools consisted, as was the rule in the acute disease observed in Manila, of mucus and blood. The microscopical examination revealed epithelial cells, red blood-corpuscles, a moderate number of bacteria and many amebæ. On the same day injections of quinin were begun, ipecac being administered by the mouth. The note 24 hours later states that the stool contained mucus but less blood. Epithelial cells were still present and the bacteria appeared in greatly increased numbers. No amebæ could be discovered. Death took place on the day of this examination.

In their pathological histology also the acute dysenteries differ from the amebic form. The histological changes appear in the mucous membrane, submucosa and muscularis, being most marked in the former situations. Those of the mucous membrane consist of coagulative necrosis with exudation of fibrin and polymorphonuclear cells. The fibrinous and cellular exudate may entirely replace the glandular layer, here and there a gland may be preserved. The pseudomembrane is a close-meshed network of fibrin enclosing multi-nuclear, often fragmented, cells. No blood-vessels are to be distinguished, but a variable number of red blood-corpuscles mingled with the exudate and lie free upon the surface. The muscularis mucosa is not always distinguishable—indeed is frequently lost in the exudate. The submucosa is always much altered. From the changes found in it, it is evident that to them is chiefly due the thickening of the gut. The part most affected is the layer next the muscularis mucosa. Here are found hemorrhages of variable size, while in the crevices of the tissues some fibrin appears. More marked, however, are cellular accumulations, which are present, not uniformly, but in irregular areas. The deeper layers of the mucosa show similar cellular infiltrations, although the amount is less striking. On the other hand, at these levels the quantity of fibrin is greatly increased and hemorrhages numerous.

The character of the cellular exudate is quite uniform. Including the red blood-corpuscles, the new cells consist chiefly of plasma cells. These are collected into foci, often about blood-vessels, veins and arteries, but sometimes occur in small groups or singly. There can be no doubt that these are identical with Unna's plasma cells; they show the reticulated nucleus, often placed eccentrically, and the fine blue granulations of cell-protoplasm in eosin and methylene-blue staining. As the deeper levels of the submucosa are reached, hemorrhages and fibrin are abundant. The size of the foci of plasma cells gradually diminishes. At the muscular border they have about disappeared. Among the plasma cells a very few eosinophilic cells may be distinguished.

In the submucosa, infiltration, hemorrhage and fibrin-formation take place also beneath an intact or almost intact mucous membrane. The nature of the cellular infiltration may be identical with that already described, but in addition accumulations of lymphoid cells may frequently be seen. These exist in the layer of the submucosa immediately next the muscularis mucosæ; the deeper cells resemble plasma cells.

The blood-vessels of the submucosa may be patent and congested, the blood containing an excess of white elements; or they may show recent leucocytic and fibrinous thrombi. Hyaline degeneration of the vascular walls was not encountered. Large spaces in the submucosa may contain fibrinous clots; these are probably dilated and thrombosed lymphatic vessels.

The muscular coat shows only hemorrhages, which may be of large size, although they are usually smaller than in the submucosa. The peritoneal tunic is usually unaltered.

From this brief description it is evident that the main pathological changes take place in the mucous membrane and submucosa and it is also clear that the 2 tunics may be affected simultaneously or the submucosa may suffer pathological alterations without involvement of the mucosa. So far as could be ascertained from the material studied, in contradistinction to the condition observed in "amebic" dysentery, ulceration did not begin in the submucosa, but any defect which may have occurred resulted from exfoliation of the necrotic mucosa and the attached pseudomembrane.

It is interesting in this connection, to emphasize the fact that the polymorphonuclear leucocyte plays a very insignificant rôle in the process of infiltration in the submucosa, whereas in the affected mucous membrane it is much in evidence. On the other hand, the blood-vessels of the submucosa contain those cells in increased numbers and the cellular and fibrinous thrombi are rich in them. It would appear, therefore, that these cells do not leave the vessels in the submucosa as readily as those of the mucous membrane. That the blood-vessels of the submucosa suffer great injury from the pathogenic agent is shown by the free hemorrhages and the fibrinous exudation.

Bacteria are abundant in the fibrinous exudation in the mucous membrane. The chief varieties distinguishable are cocci and bacilli. In specimens stained by Gram's or Weigert's methods, large numbers of cocci, in short chains and groups, can be made out. In other specimens, stained in Unna's alkaline methylene-blue, besides the cocci many bacilli may be seen. These are quite uniform in size; they present the morphological characters of the colon-typhoid group, from which they could not be distinguished in sections of tissue. While the bacteria are so abundant in the necrotic mucous membrane, diligent search failed to exhibit either bacilli or cocci in the infiltrated areas of the affected submucosa. The conviction is therefore forced upon one that the lesions in the submucosa are toxic in origin. Amebæ were not discovered in the sections.

THE BACTERIOLOGY OF PHILIPPINE DYSENTERY.

In the study of the bacterial flora of the disease acute and

chronic cases were utilized. The methods of procedure varied only slightly in different cases. The acutely ill being in bed, the evacuations were collected in bed-pans, which a short time before had been carefully scalded. The patients who were about the wards were taken to the laboratory, where cultures could be made immediately from the contents of the rectum. The fatal cases were subjected to autopsy immediately after death. The large gut at different levels was burned through with a hot knife, and cultures were made before disturbing any of the viscera. Plate cultures in agar-agar were employed. The average number of plates made from a single case was twelve. The material was mixed with bouillon, so as to afford the advantage of a relatively large amount for plating. It was frequently obtained from several different portions of the evacuation or from several levels of the intestine. Only such plates as contained well-separated colonies were utilized. Control microscopical examinations of the evacuations and intestinal contents were made. It may be mentioned that cercomonades and trichomonades were very common in the diarrheal stools. They did not appear to be of pathological significance.

From the separated colonies, agar-slant cultures were made. The growths of the pyogenic cocci as well as those of *B. pyocyaneus* were not pursued further. The former was never absent, the latter was rarely present. The bacillary colonies, which occurred with regularity in the acute disease, could be distinguished according to two distinct types. Their properties are as follows:

Type I.—Bacillus of the average size of *B. coli communis*. There is variation in length; almost none in thickness. The individuals are usually separate; sometimes they are united in pairs, but only very rarely do they occur as filaments. The ends are slightly rounded. The bacillus shows moderate motility; Gram's stain is negative.

Growth takes place upon all culture media at the room temperature, but better in the thermostat. Gelatin is not liquefied. The colonies resemble those of *B. typhosus*, being more nearly like them when first isolated from the dejecta than after a period of cultivation outside the body. After many months of such saprophytic growth the colonies become thicker, exhibit a moist surface and are less translucent. The strokes upon agar-slants show a similar alteration. At first the growth extends but little laterally, but later on it becomes 2 to 3 mm. in width, and generally shows distinct indentations at the edges. Upon gelatin the colonies are more delicate; the stab extends along the line of puncture only, spreading very little at the surface of the medium.

On potato, growth takes place along the line of inoculation and spreads beyond. After some days it is a little elevated and of a pale-brown tint. On unfavorable potatoes the growth is slight, moist and membranous, resembling, except for the greater amounts of moisture, that of *B. typhosus* when typical.

Sugars—glucose, lactose, and saccharose—are not fermented gaseously. In glucose media a moderate acid production takes place.

Bouillon is clouded diffusely and a sediment forms. There is no production of a pellicle.

Litmus-milk assumes, after 24 to 72 hours, a faint lilac tinge. After the lapse of from 6 to 8 days alkali begins to be produced, which increases in amount until the litmus is rendered deep blue in color. No coagulation of the milk ensues.

Indol is not always formed. Even in sugar-free bouillon it may fail to appear, or it may be produced in small quantities only.

Suitable cultures of this organism, when tested for the agglutination reaction with the blood-serum of persons suffering from dysentery—the host of another individual—give, in many cases, a positive result.

The bacillus is pathogenic for the ordinary laboratory animals. It is abundant in the acute cases in which it may be the predominating organism; it becomes more difficult to find as the cases progress towards recovery or chronicity. In the ordinary chronic dysentery of Manila, in which amebæ are commonly encountered, it was not found. It can be cultivated from the dejecta during life, and the intestinal contents, mucous membrane and mesenteric glands in fatal cases.

Type II.—Bacilli which are present in all instances. In the acute cases they may not predominate, being less numerous than the members of Type I. In all others it is the predominating bacterium. The properties vary somewhat, but agree well with those of the group *B. coli communis*. The main variations relate to extent and rapidity of growth upon the several culture media, the rapidity with which litmus-milk is reddened and coagulated, and the amount of indol produced. The sugars are broken up with the formation of gas. The morphology is also similar to that of *B. coli*; some specimens are motile at the end of 24 hours; in others motility was not demonstrated.

In agglutination tests the results varied according as the blood of the host or of another individual was employed. With that of the host there was frequently a reaction in low dilutions; with that of another person the reaction was rare and very inconstantly obtained. The pathogenicity was not tested extensively.

The practical operation of separating the several kinds of bacilli which grew in the plates was to inoculate glucose-agar stab-tubes from the different colonies. In those tubes which after 24 hours at 37° C., showed no gas, the organisms were likely to conform to Type I.

Before proceeding to the assumption that this organism was concerned with the production of the intestinal lesions of dysentery occurring in Manila, it was necessary to establish its absence from the stools of healthy persons and of those suffering from other diseases. Strong presumptive evidence of its being an unusual inhabitant of the intestine of man may be gathered from the facts already known concerning the ordinary intestinal flora. But as such observations would not suffice for a new region and under new conditions, the organism was searched for in other persons who had been in close association with those suffering from dysentery and also in inhabitants of other parts of the Island of Luzon. The organism was not demonstrated in healthy dejecta or in evacuations of persons (native Filipinos) suffering from beriberi. A further argument in favor of its restricted distribu-

tion is furnished by its absence from cases of chronic dysentery or the marked reduction in the numbers present.

Pathogenicity.—The pathogenicity of the bacillus Type I was studied, soon after its isolation, upon mice and monkeys in Manila, and upon various animals in this country with cultures brought from the Philippines.

Monkeys.—Subcutaneous inoculation gives rise to a swelling from which the animal suffers no inconvenience and quickly recovers. Monkeys which were given croton oil and, after purging had been established, 10 cc. of a bouillon culture through a stomach-tube, soon recovered from the effects of the purge, and no further results could be noted.

Mice are susceptible to subcutaneous and intraperitoneal inoculations. Death takes place in from 24 to 48 hours—rarely after several days—the reaction varying according to the dose and the mode of inoculation. The site of puncture shows edema and, in the case of injections made beneath the skin, a hemorrhagic exudate. Inoculation into the peritoneal cavity gives rise to a variable amount of faintly turbid exudate and small white flakes of leucocytes; the pleura contains an excess of clear fluid, which is often present also in the pericardium; the serous vessels are injected and small hemorrhages may occur, more especially in the subcutaneous tissues. The superficial lymphatic glands are swollen and congested and hemorrhagic; the spleen is enlarged, the kidneys and adrenal glands are congested; the lungs show a marked congestion and the intestines contain an excess of glutinous contents. Coverslips from the peritoneal and pleural exudates show bacilli, often in large numbers, and polymorphonuclear leucocytes. These cells frequently show engulfed bacilli. Cultures prove a general invasion of bacilli with relatively smaller numbers of organisms in the spleen and heart's blood.

Guinea-pigs react in much the same way as mice, larger doses being required to produce fatal results, while the bacilli show less tendency to invade the internal organs. Subcutaneous injections cause a local swelling consisting of pus-corpuses, serum, and blood; the superficial lymph-glands become swollen, and an exudate appears in the peritoneal and more rarely in the pleural cavities. Intraperitoneal inoculations give more characteristic results. Death took place in from 1 to 6 days depending upon the source and amount of the culture. The inguinal and axillary lymphatic glands are enlarged and reddened; the peritoneal cavity may contain glutinous fluid and floating whitish flakes of pus-corpuses, with little fluid, there may be grayish-white solid exudates of considerable size over the liver, spleen, and intestines. The blood-vessels are injected, the small intestines are filled with a soft glutinous matter, ecchymoses occur in the mucosa of the intestines, and the Peyer's patches may be swollen and reddened. If death occurs late the swelling of the Peyer's patches may have disappeared and be represented by the "hairy-beard" appearance. The liver exhibits areas of regenerative necrosis of considerable size; the adrenals and the kidneys are congested. The pleural cavity frequently contains an excess of clear fluid and the lungs are mottled. The pericardial vessels are also injected and the sac contains an increased quantity of clear fluid. The distribution of the

bacilli varies. With moderately virulent cultures they occur only in the local exudates in peritoneal and pleural cavities. In rare instances, indeed, they may disappear even from the abdominal cavity, be greatly reduced in numbers, absent from the internal organs and blood or occur there in very small numbers. This disappearance may have taken place when death has occurred as early as 24 hours after inoculation. Larger doses or intensified cultures give rise to a moderate invasion of the blood and organs. If the autopsy on these animals is delayed, especially in warm weather, an increase of bacilli in the blood rapidly takes place, so that erroneous results may be obtained. Within the local exudates the bacilli are surrounded by capsules and are often contained within polymorphonuclear leucocytes. The bacilli can also be cultivated from the fluid portions of the intestinal contents. The ingestion of cultures gives rise to no results unless the stomach-contents are first neutralized; in the latter case death may occur; the small intestine is hyperemic; the contents are hemorrhagic and mucoid and the bacilli can be cultivated from them.

The *rabbit* usually responds with a localized swelling at the site of the subcutaneous injection, from which the animal usually recovers. When the injection results fatally the local infiltration resembles that in the guinea-pig, being, however, more marked than in that animal.

Cats also succumb to subcutaneous injections. Feeding alone produces no result. If, however, croton oil be first administered and the culture be then introduced into the stomach, diarrhea sets in, the bacillus is recoverable from the dejections and death may result. In the last case the mucosa of the large intestine is hyperemic and secretes an excess of mucus. The *dog* may succumb to simple feeding of the cultures. In positive instances diarrhea sets in, the appetite is lost and death may take place in 5 or 6 days. The mucous membrane of the intestine is hyperemic; hemorrhages occur, and the cavity of the gut contains a great excess of mucus from which the bacillus may be recovered.

The dead cultures are also toxic. Certain results of the inoculations into guinea-pigs suggest that the fatal effects are due to a toxic agent rather than to an infection *per se*. Cultures killed by exposure to temperatures of 60° C. for from 15 to 20 minutes are still active. In the course of certain immunization experiments one of the goats of a series succumbed to inoculation with dead cultures. On November 22, 20 cc. of a bouillon culture, killed by heating to 60° C., were given under the skin of the shoulder. Considerable induration developed at the site of inoculation; diarrhea set in, from which the animal seemed to recover. On November 29, a second injection of 20 cc. of the culture was given; on the next morning the animal was dead. The *autopsy* showed edema over the site of inoculation. The nates were covered with thin, partly dried fecal matter. The mucous membrane of the gut was hyperemic and presented numerous punctiform hemorrhages.

Dead cultures injected into rabbits and guinea-pigs cause: (1) elevation of temperature; (2) symptoms of intoxication (especially in guinea-pigs) which may come on within two

or three hours after the injection; and (3) in rabbits, rapid recovery with a localized and decreasing swelling; in guinea-pigs, similar phenomena or death in a few hours or after 4 to 6 weeks. In the last instance the animals show great emaciation. In the case of those that have recovered from the immediate results of the injection agglutinating properties for the bacilli appear in the blood.

Has this Bacillus been Found in other Epidemics of Dysentery?—If the bacillus described is of significance in the etiology of dysentery it must occur with regularity in the disease. Whether or not it will be found to have the distribution that is necessary in order to establish this relationship, can only be determined from studies carried on in widely different places and in all forms of the disease. That the bacillus is identical with the organism obtained by Shiga in the epidemic of dysentery which prevailed in Japan, there can be no reasonable doubt. In morphological, cultural, and pathogenic characteristics the two organisms are indistinguishable.

Through the courtesy of Dr. J. H. Musser I have been enabled to study, bacteriologically and pathologically, a case of chronic dysentery contracted during the Spanish war in Porto Rico. The patient, a soldier, entered the hospital of the University of Pennsylvania in December, 1899. His dysentery dated back some months; the movements were frequently examined for amebæ with negative results. A brief abstract of the autopsy protocol is as follows:

The body is that of a greatly emaciated man about 35 years old. Dorsal decubitus. The peritoneal cavity contains a small amount of reddish fluid. The colon is thickened, and in the peritoneal surface, especially along the sigmoid flexure, shows dark points and lines of discoloration. The rectum and sigmoid flexure are contracted; the transverse colon, on the other hand, is dilated. The mucosa of the large gut is thickened throughout; in addition there are small, recent hemorrhages into its substance. There is no pronounced ulceration; the mucous membrane presents a granular aspect; there are superficial areas denuded of epithelium, and others, which are slate-colored and show dark pigmentation. The submucosa is not especially thickened except in the lower part of the gut, where there is much contraction. The mucous membrane of the transverse colon is edematous; the cecum is less affected than the colon, while the small intestine has entirely escaped. No pseudo-membrane is present except upon a small portion of the lower parts of the sigmoid flexure.

The bacteriological examination made from the contents of the hepatic and sigmoid flexures gave growths in which the two general types of bacilli already described were contained. The predominating form agreed with Type II (*B. coli communis* group); in addition, there were colonies of an organism which in morphological, cultural and pathogenic characters, and in the agglutination reaction, corresponded with the variety of bacilli represented by Type I. The histological appearances in this case differ from those in the acute disease and equally from those of the amebic variety. The changes are found more particularly in the mucosa and submucosa and represent, it would appear, a later stage in the course of the acute disease. Before describing the other changes it should

be mentioned that a striking feature in the case is the congestion in the mucosa, submucosa and muscularis. Numerous large veins, distended with blood, occupy the field of the microscope. Whether these vessels are newly formed cannot be stated positively; but they certainly are many times larger than any preexisting vessels normally met with in the same situations. In a few places the surface of the mucosa shows a necrosis of the hyaline or coagulative variety, there being no appearances of exudative fibrin in these areas. These necroses do not include the entire thickness of the mucous membrane, but cap superficial foci. There can be no doubt that this tissue-death indicates an exacerbation of the acute disease, with which, indeed, the great congestion may be partially associated.

The chief and, as I take it, characteristic changes in this stage of the disease are proliferative in character. The mucous membrane is not markedly altered in volume. Its structure is, however, greatly modified. Very few glandular crypts remain. The membrane is represented by a mass of spindle and epithelioid cells together with a reticular and coarser intercellular network, enclosing the remains of the crypts of Lieberkühn. The submucosa, also, shows a new growth of tissue, in which, however, appear much more advanced changes. The submucosa is composed of dense, almost hyaline, and structureless tissue, taking a vivid eosin stain and enclosing foci of epithelioid cells. The hardening and distortion of the gut were, doubtless, caused by this new growth of tissue and its subsequent contraction. The dilated blood vessels, mentioned above, occupy a prominent place in this coat. A variable number of lymphoid, plasma, and eosinophilic cells occur, especially about the veins.

The muscular coat is also the seat of a multiplication of connective-tissue cells, which is shown by the masses of epithelioid cells separated by muscle-fibers, as well as an increase in foci of the fibrous tissue.

Blood-pigment is present both in the muscular and the subperitoneal coat.

The careful bacteriological studies in Egyptian dysentery made by Kruse and Pasquale, contain numerous references to typhoid-like bacteria. Critical examination shows the majority to belong to the groups of *B. coli communis*. The typhoid characteristics depend merely on cultural resemblances—most marked in growths on agar-agar. Fermentation and their effects upon milk eliminate the suspicion that they may be typhoid bacilli, or the organism obtained by Shiga in Tokyo, or by myself in Manila. Still other examples of bacilli, similar to and possibly identical with *B. dysenteriae* (Shiga), have been found in dysentery, though they are not suspected of standing in any etiological relation to it. Pansini studied 4 cases of abscess of the liver, 3 of which followed dysentery. The bacilli, which were isolated, resembled *B. typhosus*—indeed, Pansini could not distinguish between the two series. Babes also, although only in a single instance isolated such an organism from a case of dysentery.

Since the publications of Shiga's studies, Eserich and Celli have both attempted to show that the organisms obtained from their respective epidemics of dysentery are

identical with the *B. dysenteriae*. In both cases they have proceeded upon the false assumption that Shiga's micro-organism was a variety of *B. coli communis*, whereas, in point of fact, it is much more nearly related in its cultural and physiological properties to *B. typhosus*.

The question naturally arises, In what ways does it differ from *B. typhosus*? Comparison of the Eberth-Gaffky and Shiga bacilli show the criteria of difference to be by no means numerous. The main features, however, are as follows: The latter shows less marked motility when first isolated and a tendency to lose motility rapidly in artificial cultivations; it displays a more uniform generation of indol; after a brief preliminary acid production in milk it gives rise to a gradually increasing alkalization; it is inactive to blood-serum from typhoid cases; but reacts with serum from dysenteric cases to which *B. typhosus* does not respond.

The Agglutination Test.—While the absolute value of this test in determining the specificity of bacteria may be open to doubt, its use in differentiation is now unquestioned. Undoubtedly there are limits to its usefulness, and experience (gained especially in typhoid fever) has shown that the changes upon which the property of the blood-serum depends for its evolution in certain instances may fail to take place. The tests in the case of the bacillus isolated in Manila were made at the time with blood obtained from acute and chronic cases of dysentery, occurring there and in the surrounding country. For carrying out the tests the blood was obtained in capillary tubes from the lobe of the ear of the living, and in larger quantities directly from the cavities of the heart by means of sterilized pipettes from the fatal cases of dysentery. The tests were made under the microscope and by growing the organisms in mixtures of bouillon and blood-serum. After our return to this country, the blood-serum from the case of Porto-Rican dysentery was employed and gave positive results. Through the courtesy of Assistant Surgeon Craig, stationed at the Presidio at San Francisco, I obtained capillary tubes filled with blood taken from convalescents and other soldiers suffering from chronic dysentery acquired in the Philippines. The present status of the agglutination reaction may be summed up as follows:

Positive results were obtained with cases definitely known to have been infected with the microorganism in question. The results obtained from the blood derived from chronic dysentery were more variable. Dr. Osler has written me of his experience. In several cases of amebic dysentery which have come under his charge in the Johns Hopkins Hospital, the blood-serum failed to produce the reaction with the bacillus obtained in Manila; in one case of the Porto-Rican disease a positive reaction was given.

The above results tend to emphasize the distinction of types of dysentery occurring in the tropics. They further tend to confirm the possibility that the acute dysenteries are caused by *B. dysenteriae*. To what extent the organism is concerned with the production of chronic dysentery remains to be established. That we must recognize a chronic form of tropical dysentery that is not in its entire course associated with the presence of amebæ in large numbers, and that possesses totally

different pathological lesions, is certain. I am inclined to the opinion that this type is not the commonest form of chronic tropical dysentery, and that it is less frequent than the amebic type. As it appears to be the form that gives a positive serum reaction with *B. dysenteriae*, its extent and distribution may now be open to investigation.

Bearing directly upon these considerations are the results of Lieutenant Strong's studies continued after our departure from Manila. He writes: "After you left we had a large number of acute cases of dysentery. It seems certain that this form, which we have begun to speak of as *acute infectious dysentery*, is independent of amebæ. I have now records of 14 cases (not all were fatal) which I studied bacteriologically. From the stools in all of these, there has been obtained a bacillus which agrees with the organism obtained by you. I have also obtained the organisms from the mesenteric glands in three fatal cases. In one case of acute dysentery with secondary acute fibrinous peritonitis I obtained it from the exudate. The agglutination reaction is not invariable. Amebæ were never demonstrable in any of these 14 cases. On the other hand, in every case with certain anatomical lesions we always find the amebæ. In some cases of dysentery in which the amebæ were absent and the bacilli present, that have lasted four to five weeks (one case lasted nearly two months) and then resulted fatally, we see a continuation of the same process that is observed in the acute fatal cases. The lesions are those of necroses of the mucous membrane and induration of the gut."

Protective Inoculation and Serum Therapy.—It is not unreasonable to hope that with the discovery of the specific cause of dysentery, particularly if it proves to be a bacterium capable of being artificially cultivated, means will be found by which protective inoculation may be carried out with effect and safety. The fundamental conditions underlying such immunization are now fairly established, and two general methods of accomplishing such results are open to investigation. In the first place, an active immunization may be achieved through the use of cultures of a determined grade of activity; in the second the serum of animals may be employed either as a therapeutic agent or to provide a passive immunity.

It has been found possible, through the use of cultures destroyed by heat or the addition of chemicals (tricrosol), to protect small animals from subsequent inoculations with virulent bacilli. Larger animals, such as the goat, when treated first with the dead and afterwards with the living cultures, develop a gradually increasing resistance to the inoculations; their blood-serum assumes highly agglutinating qualities for the bacillus, and coincidentally acquires protective and healing properties. My own experiments relating to this topic have been carried out on small animals only. Shiga, has, however, been able to test the serum upon human cases. Dr. Eldridge² in his report gives the following figures: Up to November 1, 1899, Shiga had treated with the serums in 1898 in Laboratory Hospital, 65 cases, death-rate 9 per cent;

² Public Health Reports, Vol. XV, No. I.

in 1899 in Laboratory Hospital, 91 cases, death-rate 8 per cent; in 1899 in Hirowo Hospital, 110 cases, death-rate 12 per cent. During the same period of 1899 there were under ordinary treatment at Tokyo: at Honjo Hospital, 166 cases, death-rate 37.9 per cent; at Hirowo Hospital, 53 cases, death-rate 37.7 per cent; at Komogome Hospital, 398 cases, death-rate 34.6 per cent; in private houses, 1119 cases, death-rate 28.5 per cent.

I should, however, expect greater benefit from a species of vaccination, especially to those exposed to the endemic or endemo-epidemic dysentery of the tropics. The encouraging results of the injections of the dead bacilli of Asiatic cholera and typhoid fever render justifiable the use of a similar procedure in persons exposed to dysentery. The practical details of such inoculations will, of course, be established only after trials, preferably upon human beings who are anxious to submit to this method of treatment. I have found it possible to prepare cultures which after being killed possess a definite degree of toxicity for guinea-pigs. The only example of an experiment upon man yet available is that performed by Shiga, who directed that about $\frac{1}{12}$ of an agar-culture, suspended in bouillon and killed by heat, should be injected into the subcutaneous tissues of his back. The immediate results of the injection were pain in the head, slight chill and fever, and local infiltration. After five or six days—the symptoms having in the interim entirely disappeared, except for some slight swelling—this area of infiltration increased and called for incision. The subcutaneous tissues were found thickened, indurated, and infiltrated with pus, which was sterile to cultures. The local lesion, similar to those in animals, was, it is thought, produced by the toxic substance contained within the dead bodies of the bacteria. Immediately after incision, all disagreeable symptoms subsided except the local infiltration, which disappeared gradually.

If this experiment can be taken as an index, the poison of *B. dysenteriae* is more active than the analogous substance contained in the bodies of the typhoid and Asiatic cholera

organisms. This objection, if true, could be eliminated by dosage, or, if necessary, by combining the vaccine with immune-serum, as has recently been recommended by the German Plague commission in carrying out the inoculations with the Plague bacilli. Shiga's blood-serum, 10 days after the injection, showed active agglutination of the bacilli.

An interesting, if somewhat disagreeable accident, was experienced by one of the laboratory assistants in Baltimore. In studying the acid production of the Manila bacillus a small quantity of fluid culture was aspirated into the mouth. The culture was expectorated and the mouth rinsed with a weak carbolic-acid solution. Notwithstanding this precaution a severe diarrhea, with bloody and mucous stools, pain and tenesmus developed within 48 hours. I was in Philadelphia at the time and the scientific ardor of the patient was so greatly depressed as a result of his discomfort and suffering that cultures were not made from the dejections, nor was I notified of the accident until several weeks afterwards.

Very little remains for me to say at this time. It is only natural to ask whether the foregoing considerations justify a belief in a specific organism of dysentery. My own sense is against that belief, although it must be conceded that the varieties of the disease are fewer than the clinical and pathological-anatomical conceptions of the time would lead one to suppose. Excluding the sporadic cases, which need a much closer bacteriological study than has been yet accorded to them, it is entirely possible that two specific organisms may be responsible for the epidemic and endemic diseases *per se*. I think that I have shown that tropical dysentery consists of a bacillary and an amebic form, separable in their early and their later stages by their clinical histories, their etiology and pathological anatomy. It is important to know whether the epidemic disease is more uniform in its causation and pathological anatomy. The studies of the Japanese disease by Shiga are highly suggestive of this interpretation, but additional observations will be required before we can accept as final his conclusions.

A CONTRIBUTION TO THE STUDY OF THE ANATOMY AND PHYSIOLOGY OF THE PROSTATE GLAND, AND A FEW OBSERVATIONS ON THE PHENOMENON OF EJACULATION.

BY GEO. WALKER, M. D.,

Chief of Surgical Clinic, Johns Hopkins Hospital Dispensary, Baltimore.

It is not the purpose of this paper to go into the complete anatomy and physiology of the prostate gland; but to discuss some points, in relation to its finer histological structure, which have not hitherto been clearly elucidated.

Review of the literature.—In the literature many papers have appeared from time to time, but the ones that show exact investigation are strikingly sparse. In most of the various works on histological anatomy the descriptions are

short, superficial, and in not a few inaccurate. By Henle,¹⁸ Kölliker,²⁴ Sappey,⁴¹ and L. Testut,⁴⁸ much more detailed, and better accounts, are given.

Home,²² in 1806, announced the discovery of a third lobe, posteriorly, between the two lateral ones. For many years this view was accepted by all the English anatomists, but denied by the French. Later, Thompson,⁴⁰ in 1857, made some careful examinations of a large number of cadavers; and

arrived at the conclusion that it is only occasionally present, and does not deserve the name of a third lobe. Recently, these observations have been confirmed by Griffiths.

Pettigrew,³⁶ Bell, Sabatier,³⁹ and Shaw⁴² have described the gross structure and muscular arrangement, with varying degrees of exactness; but, unfortunately, their accounts by no means agree.

The embryology has been studied by Tourneux⁵⁰ and Mihálcovicz;⁵⁰ and the evolution, in dog and man, by Regnaud.⁵⁷

In Rüdinger's⁵⁸ monograph very good observations are given on the caput gallinaceum and prostatic glandular substance, but the stroma is rather superficially treated.

Stilling⁴⁵ has made a careful study of the cellular elements in rabbits and man, with reference to the origin of the concretions. He observed the organ, before and after coitus, and at different seasons of the year.

Langerhans²⁵ gave the best account, up to that time (1874), of the glandular tissue in man.

Svetlin⁴⁷ made a series of investigations, in order to establish definitely the exact number of ducts. He found after the examination of numerous adult glands that the number varied between fifteen and thirty-two.

The work of Griffiths is well known, and is probably the most practical that has been done on the gland. He has busied himself more especially with the changes that occur at different seasons, at different ages, and after various operations.

In the writings of Oudemans³⁴ and Disselhorst,⁸ very good general descriptions of the gland are found; but the scope of the work was too broad to permit a minute histological investigation.

The opinions regarding the organ as a gland are very diverse. Thus Ellis¹⁰ says its chief office is muscular, and he thinks the term "gland" should be abolished.

Handfield Jones¹⁸ is of the opinion that it should be looked on as an aggregation of scattered tubules, rather than a gland proper.

Harrison¹⁷ acknowledges the existence of the glandular substance, but holds practically the same view as Ellis.

Henle, Kölliker, and Sappey give prominence to its glandular nature; while Stöhr,⁴⁰ Orth,³³ and many others state that the organ is largely muscular.

Griffiths affirms that its chief function is glandular, and that it is entirely connected with the sexual organs.

Material used. The research was made on specimens obtained from man, the dog, cat, swine, mole, hedgehog, bull and hamster. Most of the work was done on the dog, as human material could not be obtained of sufficient freshness to permit of a study of the finer histology. Comparison has convinced me that no great difference exists between them. In man, the glands were examined in the adult, new-born and embryo; in the dog, in all stages of development; in the cat, full-grown and new-born; in swine, full-grown, castrated, and embryo; in the hedgehog, full-grown, half-grown, and embryo;

in the bull, mole and hamster only full-grown animals were utilized.

Method and technique.—The glands of the animals were taken immediately after death, and fixed in the following fluids: Zenker's, Herman's, Flemming's, van Gehuchten's; alcohol in various strengths; formalin 5% and 10%; sublimate 1%, 5% and concentrated; osmic acid, both by injection and maceration; diverse combinations of picric acid, formalin, and alcohol; acetic acid, sublimate, and picric acid; sublimate and osmic acid; chromic acid; and lastly a mixture of 3% pot. bichrom. and 5% acetic acid.

The best cell fixation was obtained by Flemming's solution, 5% sublimate, and the mixture of 3% pot. bichrom. and 5% acetic acid. This last named gave a very beautiful cell outline and protoplasmic preservation, which equaled, in every respect, Flemming's. The best preservation of the muscle was obtained by 5% sublimate, Zenker's fluid, and 5% to 7% formalin; and the best connective tissue in alcohol, 5% and concentrated sublimate, and a mixture of alcohol and sublimate.

The glands were all imbedded in paraffin, and cut in varying degrees of thinness; from 2 to 20 mm. For a study of the cells, 2 to 4; for connective tissue by the digestion method, 4 to 6; for elastic tissue, 12 to 20; for muscle, 18 to 20.

Transverse and longitudinal serial sections were made in the new-born child, in the half-grown, and new-born dog. Transverse, in the adult cat, full-grown, half-grown and embryo hedgehog, and embryo swine.

All the approved staining agents were tried, with varying degrees of success. The one found to give the clearest definition of nucleus and protoplasm was Heidenhain's iron-hæmatoxylin, alone, and counterstained with a 1% aqueous solution of rubin. In several instances a very beautiful nucleus was obtained by gentian violet, after osmium fixation; but no satisfactory result could be had with thionin.

For the muscle Van Gieson's picrofuchsin method was employed. Many consider this a very delusive and unsatisfactory stain, but I found quite the contrary to be true. Tissues fixed in Zenker's, alcohol, formalin, and sublimate, stain well; osmium preparations and specimens that have lain for a long time in chrome solutions take it poorly. After a method of Dr. Hoehl, I usually applied an aqueous solution, of 1% iod. kal. and 0.5% iodine, previous to staining. This is a very important addition, and enables one to get a good result, where the picrofuchsin would hardly tinge the section. The connective tissue showed with greatest distinctness in specimens fixed in a mixture of picric acid, formalin and alcohol. The staining will be discussed under the connective tissue.

The work was done in the laboratory of Prof. Dr. Spalteholz; for whose great kindness and efficient help let me here express my heartiest and most sincere thanks. Also to Professor His for materials given, and for the use of his microscopic sections. To Dr. Hoehl thanks are also due, for showing me the method of digestion, and for various points in staining.

THE POSITION AND ARRANGEMENT OF THE MUSCULAR ELEMENTS.

On a superficial examination of the prostatic muscle, one sees a complicated network, of crossing and recrossing fibers, without apparent order or regularity; and it is only after a careful study of a number of serial sections, made from the gland in various stages of development, that a correct idea of their position and direction can be obtained. It must, therefore, be owing to this cause, that these various contradictory statements are found in the literature of this subject.

Review of the literature.—The internal sphincter of the bladder is spoken of by most anatomists as a thickening of the circular coat around the neck of that viscus. Others, Guthrie,³⁰ Taylor,³⁰ Bedford,³⁰ Hancock,³⁰ and lately Griffiths,¹⁴ deny the existence of any such thickening, and assert that there is no real sphincter.

Pettigrew³⁰ recognized no directly circular fibers, and thought that they all ran in an oblique manner.

Into the caput gallinaceum, according to Morgagni³¹ and Santorini,⁴⁰ were inserted muscular bundles, coming from the ureters. Chas. Bell³⁰ denied this, and claimed that they extended to the third lobe of the prostate. I shall attempt to show later on that both of these opinions are incorrect.

Ellis¹⁰ regarded the prostate as essentially a muscular organ; consisting of circular and orbicular fibers, which are directly continuous with the bladder behind, and the urethra in front. According to him, it should be looked on as a specially developed portion of the circular muscle coat that envelops the urethra behind the bulb or spongy portion.

Hodgson¹⁹ described the gland thus: "The muscular structure, from the mucous membrane of the urethra to the capsule of the prostate, may be considered as a general muscle coat of the urethra; interspersed with glandular tissue, and somewhat altered in form to adapt it to its new condition."

Sabatier³⁹ was of the opinion that the prostatic muscle is made up entirely of circular fibers, which are not connected with the bladder. He described two circular layers; one belonging to the urethra, and the other to the prostate; the fibers of one being arranged excentrically to those of the other.

Pettigrew³⁰ enumerated seven layers which were continuous with those of the bladder. He considered the verumontanum to be mainly a muscular body which had an important muscular connection with the urethral orifices.

R. Harrison¹⁷ (1886) asserted that the prostate is a largely muscular organ, whose chief function is to support the bladder. Later, in 1889, he cited a number of cases to show that the gland acted as a sphincter for the bladder. In one case, he explained incontinence of urine as being caused by a want of development of this gland. In the last edition of his book, in 1895, he says he has had no reason to change his opinion.

Kölliker²⁴ states that the gland is surrounded by a thick muscular capsule, from which septa pass into the substance of the organ. He describes a circular muscle extending more or less around the gland, and a second longitudinal, situated

near the urethra. The arrangement about the single lobules is not given.

Griffiths¹⁴ thinks that the prostatic muscle develops from the circular coat of the urethra, and is arranged in a circular manner about the lobules. It is only indirectly connected with the circular coat of the bladder.

Sappey,⁴¹ Henle,¹⁸ and L. Testut⁴⁸ say that the muscle is so disposed around the lobules, that they may be forcibly compressed.

In the majority of the books on histology there is no description given further than the assertion that the prostatic stroma is largely composed of muscle which extends from the muscular sheath surrounding the gland.

After having made a study of the gland in the before enumerated animals, I have arrived at conclusions which do not entirely agree with those previously set forth. In order to increase the clearness of the description, it is thought best to give the position and arrangement in the full-grown dog as seen in a series of transverse sections; beginning at the vesical neck, and going to the apex or urethral end.

First, there is met a bundle of thick muscle which is arranged principally in the circular direction; internally and externally to this is a thin longitudinal layer. As stated above, several anatomists deny the existence of this in man, but it was plainly to be seen in all the dogs examined. Hanging somewhat in relation, but not in immediate connection with the above sphincter, is a thick muscle whose fibers run longitudinally, circularly, and obliquely; the majority seem to take the last named course, and are disposed concentrically around the basal prostatic lobes. This muscle tapers, and becomes thinner towards the bladder; and in several instances there was a distinct fibrous septum between it and the vesical muscles. The bundles are smaller and much more compactly arranged than those of the bladder, and are on entirely different axes. The muscle encircles the entire urethra at this point; but the fibres are excentric to the urethral axis, thus being in strong contrast to the concentric circular coat. It is clear, therefore, that this muscle is not definitely connected with the urethra or bladder, but is associated entirely with the prostate. It is somewhat triangular in shape, and fills in the angle formed by the prostate and vesical neck. From it, projections are sent into and around the gland, in a complicated manner.

Anteriorly, a thick triangular-shaped projection lies in the middle, between the two halves; a second division, about one-half the size of the first, is placed outwards on the side of the gland. Posteriorly, it projects in a similar manner, connecting the two sides, and lying between the urethra and ejaculatory ducts; this is much thinner than the anterior portion.

The anterior division is pyramidal in shape, with the base on the surface, at which place it is 2 mm. in breadth; from base to apex 4 to 2 cm. It extends to near the middle of the gland, longitudinally, where it becomes very thin. The bundles of fibers run in various directions; the circular and oblique preponderate. It extends on both sides into the substance of the organ, on either side, penetrating between

and surrounding the lobules. The fibers diverge, passing from the side of one lobule to the opposite side of another, and so on, thus forming a figure-of-8 network around them. A dense thick sheath passes forward on the outside of the gland, and hugs the glandular substance very closely; this becomes gradually thinner, and disappears at the junction of the lateral and lower borders. On the surface of this sheath, there were seen numerous depressions which corresponded to spaces between the lobules; here the muscle undergoes very marked thickening, and gives off small septa which ramify in the substance of the gland.

As the middle is approached, the muscle becomes much thinner, more deeply situated, and the fibers assume a more longitudinal course. Now, to return to the posterior portion—vesical half—we find here the muscular bundles are not so compactly disposed, and their course can be more easily made out. In the center the fibers are distinctly circular, while immediately before and behind they are longitudinal. This mass lies between, and connects the hemispheres posteriorly; it extends on both sides into the substance and diverges around the lobules in the same way as in the anterior portion. Behind the above layer, and lying well out towards the periphery, there is a bundle of longitudinal fibers, which are entirely separate from the other layers; these increase in the urethral half, the bundles become larger and more aggregated, assuming a cord-like shape. As the end is approached, the two sides close in around this mass, and place it well up in the substance; still further on, the fibers assume an oblique course, and enter into the gland substance. In this region they become mixed with the longitudinal coat of the urethra, but are not a continuation of it, as is stated by many anatomists. The muscle is four or five times as thick as that of the urethra, and its fibers are arranged on a different axis. As we follow the sections we find, about the middle of the urethral half, a distinctly circular layer enclosing the urethra and several lobules of the gland. At this place there seemed to be a definite connection with the urethra, but in passing on they became entirely separate, and the urethral coat was seen to be distinct.

The urethral end, corresponding in man to the apex, is covered by a thick sheath of muscle, which lies in direct connection posteriorly with the above-described muscle, and slightly so with the anterior division. It extends deeply on the urethral surface, and on the upper surface is continuous with the sheath from the vesical end; on the lateral surface there is a break in continuity, which leaves a boat-shaped area over the base of one lobe, entirely uncovered with muscle. The gland is then, contrary to the generally accepted opinion, not completely surrounded by a sheath of muscle. From this layer, septa pass in between the lobules, and join those coming out from the vesical portion. I wish here to note especially the fact that the urethral end of the prostate stands well out from that canal, and that there is an entire separation of the smooth muscular elements.

On the upper and lateral surfaces, there is a thin longitudinal layer, which is continuous with the corresponding

coat from the bladder. The bundles are sparsely scattered in the vesicorectal fascia, and partly within the capsule; they become thinner and sparser, and finally disappear towards the urethra. It is stated by Pettigrew, Sabatier, and others, that this muscle is directly continuous with the outer urethral coat; but such was not found to be the case, in any instance. Underneath this, on the vesical half, there is occasionally present a thin circular layer; it is a continuation of the coat of the bladder and extends only a short distance out on the upper and lateral surfaces.

The septa, as before mentioned, are offsets from the posterior and anterior muscle masses and external sheath. They are thickest towards the periphery, and extend between the lobules as strong muscular partitions; in the interior, they divide, and become thinner and thinner; so that towards the urethra they disappear entirely. The course and disposition, as seen in the transverse sections, are so complicated that no definite order can be discerned; but by a study of the different axes a beautiful arrangement is to be made out. The fibers run in a circular and longitudinal manner; the circular are thickest and ramify among the lobules in a figure-of-8 course, thus enclosing each in a circular sheath, but not encircling them in the way described by Griffiths. Internal to this is an oblique or longitudinal layer, which lies immediately next to the gland substance, and encases the lobule more or less completely. The fibers commence near the apex, course along the side, bend over the base and run down the opposite side. This coat is probably in connection with the coats of the other lobules, but this point could not be definitely decided. This inner coat is interspersed between the finer divisions of the alveoli; the outer is seen only around the lobule. Lusena has described the longitudinal fibers in man, but makes no mention of the circular ones.

The individual fibers lie very near the cellular layer, being separated only by capillary blood-vessels and a basement membrane. In other areas a sheath of connective tissue is also interposed. The muscle-cells are long and well developed, with large oval nuclei situated near the center. In many places they could be seen directly inserted into connective tissue.

Crossed striated muscle.—This was present only in the portion of the urethral half; it is derived from that part of the sphincter urethræ externus, called the sphincter vesicæ externus, or sphincter of Henle. This muscle is made up of an outer thick layer of circular fibers, and an inner very thin sheath of longitudinal ones; these form a bridge between the two sides of the gland and penetrate among two or three lobules. In the periphery it forms a partition consisting of four or five fibers; deeper, only a few cells are seen scattered in the smooth muscle. In the cat the mixture was so intimate that it appeared as if one were inserted into the other. The longitudinal fibers extend more deeply, and can be followed to the center of the gland; they are interspersed from the surface to near the urethra, in the anterior fibromuscular septum between the hemispheres.

Muscles of the prostatic urethra.—First, on the vesical end:

the longitudinal external coat of bladder is continued over the prostate, as has been described. The circular ends at vesical neck. The internal longitudinal fibers, anteriorly, end in the connective tissue around the beginning urethra; posteriorly, they are inserted into the uvula vesicæ. On section, this body projects prominently into the commencement of the urethra, and very much resembles the form of the caput gallinaceum. This probably accounts for the belief held by Morgagni²¹ and Santorini²² that muscular fibers extend from the urethral orifices, and are inserted into the caput gallinaceum. From the border of the uvula vesicæ to near the middle of the gland, very little muscle is seen around the urethra; towards the center, the posterior and lateral walls, there are seen irregularly distributed muscular elements, largely mixed with connective tissue. The fibers are small and short and very irregularly disposed, and cannot be said to form a definite coat. They are present in the base of the verumontanum, but not in a greater degree than in the other urethral folds. In the outer portion it is somewhat removed from the urethral mucous membrane, and lies posteriorly; further on, the muscle is connected with the longitudinal coat of the urethra. In the anterior and posterior portions of the urethral half, situated near the surface, there are present a few scattered bundles of longitudinal fibers which can be traced back into the urethra. The circular layer of urethra becomes more or less incorporated with the prostate, but there is no definite connection. In many glands the cellular elements encroach so near the urethra that nothing remains of the wall, other than a thin submucous connective-tissue coat.

To condense the foregoing into a few words, it can be said: That the vesical end of the prostate is surrounded by a thick muscle composed of longitudinal, circular, and oblique fibers, from which a large process projects anteriorly and posteriorly between the two glandular hemispheres; and a thick sheath is sent out on either side, which encases the fore, lateral, and dorsal surfaces. The posterior process extends to the urethral end, where it spreads out around the external surface in that region. From these muscular divisions, septa pass into the gland, and surround the lobes in a circular and longitudinal manner, giving to each lobule two distinct coats.

The muscle coats of the urethra and bladder are inserted into the prostate, and not continued through it, and the urethral coats in the prostatic portion are replaced to a considerable degree by prostatic substance.

Caput gallinaceum.—This organ is spoken of by Pettigrew as being essentially muscular. That it contains muscle is true, but that its bulk is muscle is erroneous. Around the glandular portion there is placed a moderately thick layer of circular fibers which serve to expel the secretion. The other muscular elements seen therein are derived from the ejaculatory ducts, which retain their muscular coats to very near the mouths. In the lower portions the sheaths are quite distinct, while higher they become blended.

New-born child and dog.—The general shapes of the prostates in these are different, but their histological structure is

very similar. By a study of a series of sections, cut in the longitudinal direction, it is clearly to be seen that the longitudinal coat of the urethra diverges and runs in various directions between the lobules; while at the other end the circular coat of the bladder spreads out and ramifies in the gland, in a like manner, but in a different course.

These pass through the gland more or less at right angles to each other; the one circularly, the other longitudinally; thus giving every lobule two coats. In sections from the child, both could be easily observed; the inner being longitudinal and the outer circular. According to Griffiths²⁴ all the prostatic muscle is developed from the circular urethral coat; my examination has led me to a different conclusion.

In the hedgehog, mole and hamster, there is a separate circular coat for each lobule; and in the hedgehog a few longitudinal fibers are present. In the cat a similar disposition is present as in the dog. In swine the muscle of Wilson envelopes the whole gland.

It will be seen from the foregoing, that the prostatic muscle primarily develops from the muscular elements of bladder and urethra; but later it becomes entirely separate and exists as a definitely distinct muscle. It is composed of two sets of fibers, so disposed that each lobule may be individually compressed; and the gland as a whole, by the thick anterior and posterior layers. The whole muscular structure is arranged primarily, to compress the prostate, and not to act as a vesical sphincter, as has been supposed by many anatomists; notably by Harrison.²⁷ It is true that in the dog the gland must give the necessary constriction to the urethra, as the walls of the latter are very nearly replaced by it; but to say that it is a special sphincter is, I think, entirely erroneous.

First: On account of the anatomical reason given above.

Second: In the cat, and a number of other animals, the organ is situated at quite a distance from the bladder.

Third: In the hedgehog, mole, and animals of this class, it is above the urethra, and extends outwards and away from it.

Fourth: Horses and swine, which are commonly castrated in youth, do not suffer from incompetent bladders.

Fifth: In females the gland is absent, and no representative muscular structure is present; if its function were that of a sphincter, it would be found in them, even as in males.

Sixth: Men in whom there is want of development, or atrophy of the gland, do not suffer from incontinence of urine (Griffiths).

Seventh: If the muscle were connected in function with the bladder, it would not so completely atrophy after castration.

The strict prostatic nature of the muscle is also borne out by the evolution of the organ. I have noted in the very young glands that the lobules project out beyond the muscle, and the latter is later developed around them. This is also corroborated by Regnauld²⁸ and Mihálcovics.³⁰ The latter writes: "Da die Prostatadrüsen früher zur Entwicklung kommen als die Musculatur, so scheint die mächtige Ent-

wicklung der letzteren eine secundäre Folgeder ersteren zu sein."

Amount of muscular tissue.—The muscular elements form in the dog about $\frac{1}{2}$ of the substance; in man, about $\frac{1}{4}$. Notwithstanding these facts, the organ is spoken of by Orth,³³ Stöhr,³⁴ and numerous others as being largely muscular. Thus Stöhr in his Histology says: "Die Prostata besteht zum kleineren Theile aus Drüsensubstanz, zum grösseren Theile aus glatten Muskelfasern." Ellis goes much further, and gives as his opinion that, as there is so little glandular substance, the propriety of calling the organ a gland is doubtful. These opinions are either the result of incomplete investigation or the examination of abnormal glands.

Ejaculatory ducts.—These retain their muscular walls to within close proximity of their openings on the crest of the caput gallinaceum. Henle³⁵ thought the muscle blended with that of the prostate; in some sections this appeared to be the case, but as the ducts were followed, it became evident that they were quite distinct. Finger speaks of a ring muscle around them, to act as a sphincter; this I did not observe; on the contrary, the walls got thinner as the mouth was approached.

POSITION AND ARRANGEMENT OF THE CONNECTIVE-TISSUE ELEMENTS.

The stroma is described in most articles on the prostate, as consisting largely of muscle; the connective tissue being supposed to play an unimportant rôle; and in the literature very little is said about it. Klein affirms that the stroma is essentially muscular; the connective tissue is present in very small amount and is situated in the capsule and finer glandular septa. Sappey, Henle, and L. Testut, all of whom give relatively lengthy descriptions, do not say anything exact in regard to it.

The glands of the adult, new-born, and embryo man and dog, in different stages of development, were examined.

This tissue was studied by the digestion method, and by staining with fuchsin, nigrosin, and Mallory's hæmatoxylin. Among the stains, the last named proved by far the best, and gave extremely clear and beautiful demonstrations of the finest fibers. My thanks are due to Dr. Caspari for specimens furnished.

The idea that the connective tissue is insignificant in amount is proved by the digestion method to be erroneous. It is shown to be relatively abundant, and will compare favorably with the reticulum of other secreting organs; it is amply sufficient to furnish the necessary support to the glandular structure, independent of the muscular tissue. The latter, no doubt, lends additional strength, but it is not placed in the gland for this purpose.

In the new-born and young animals, the connective tissue is in considerable quantity, forming about one-fourth of the organ, and is very rich in cells. As age advances, it becomes more fibrous, and is replaced to a certain extent by smooth muscle.

As found in the full-grown dog, it is arranged in the fol-

lowing way: On both the urethral and vesical ends there is situated, anteriorly and posteriorly, a thick wedge-shaped mass. Posteriorly, its shape is somewhat changed by the upward projection of the sulcus in this region. In the urethral half, similar, but slightly smaller, masses are seen. Toward the center of the prostate, longitudinally, the glandular substance very nearly approaches them, and the tissue becomes correspondingly thin. From these masses, thick, dense sheaths extend, and spread over the anterior, posterior, and lateral surfaces. Toward the median line, urethral and vesical ends, the gland is thick and contains a large proportion of muscle; while on the lower lateral surface it is thin, with no muscle. From this thick central portion, and from the anterior and posterior masses, broad and strong septa are sent into the substance and form partitions between the lobules; these in turn divide and ramify in the cellular tissue, forming a honey-comb network on which the cells rest. Into the alveolated spaces thus formed are yet finer projections which support a layer of cells and carry a capillary blood-vessel. Surrounding the urethra is a thick and dense mass, which cannot be differentiated from the stroma of that canal; from the lateral surface four to five similar septa, as was noted above, pass outward and join those coming from the exterior; these are broad near the urethra, and contain very little muscular tissue.

Lying immediately under the cells, and separating them from the capillary, is an extremely fine and delicate layer of apparently almost structureless tissue.

In these digested specimens, and those stained by Mallory's hæmatoxylin, it was very plainly visible. By the high power, it was seen to consist of extremely fine connective-tissue fibers. This forms the membrana propria, on which the cells directly rest; in several instances extremely fine elastic fibers were interspersed in it. The existence of a basement membrane has been denied by many; and others have held very diverse opinions in regard to it. Disselhorst affirms that the membrana propria, as seen with an oil immersion, consists of a structureless membrane. Regnaud, who has made a careful study of the gland in dogs, states that none is present. Stöhr affirms that it is very hard to demonstrate it in the human subject. Griffiths thinks it is composed of small epithelial cells. Stilling also says it is made up of small round cells. Langerhans is of the opinion that it cannot be differentiated from the remaining connective tissue. On account of the poorly preserved condition of the human tissue, I have not been able to demonstrate its presence; but, as it is found in all the other animals, a doubt can scarcely be entertained as to its existence in the human subject.

Connective-tissue cells, mast and plasma cells, and leucocytes were scattered throughout the connective tissue, being most numerous in the larger septa in close proximity to the cellular layer. In the active stage they are present in greater numbers, and in younger animals they predominate.

Incorporated in the stroma is a large quantity of muscular tissue, and running through it are myriads of small blood-vessels and capillaries.

In old age the connective-tissue elements become much in-

creased, by their own hyperplasia, and by a degeneration of the muscle. In castrated animals the gland is almost entirely transformed into connective tissue.

DISTRIBUTION OF ELASTIC TISSUE.

The elastic tissue is spoken of by Romiti, Böhm and Davidoff,³ Debierre,⁷ Rauber, Henle, Quain, and others, as forming a part of the prostatic stroma, but no description is given. The only special work that I have found is by A. Antonini. He delineates a more or less concentric coat around the urethra, which he calls the *fasci peri-ultrali*; a thin crescentic layer under the mucous membrane of the verumontanum, the *fasci otricolari*; and those in the gland, *fasci glandulari*. Although we both worked on the dog, I have not found exactly the same arrangement.

Transverse and longitudinal sections were made from the dog, at different ages; and in man, both adult and new-born. Three methods of staining were employed; namely: Unna's orcein; Weigert's iron fuchsin; and Spalteholz's elastic-tissue stain. The last named proved by far the best and brought out the fibers with a clearness that could not be obtained by the others. A modification of Weigert's was employed, which very greatly improved the stain. It is as follows: Stain in the usual way for 45 minutes; wash carefully with water, then thoroughly with 96% alcohol; stain for one minute with a concentrated solution of picric acid in 96% alcohol; wash out surplus picric acid with common alcohol, then with absolute alcohol; clear in xylol and mount in the usual way. This counterstain gives a yellow background to the black fibers, thus greatly adding to their clearness, and bringing into view the finer ones which were invisible. A trial will convince one of the value of this addition.

First, lying just under the mucous membrane of the urethra, and completely surrounding that canal, is a sheath of longitudinal fibers. These are thicker in this region than on the other portions of the urethra, but are directly continuous with the urethra in front and the bladder behind. The outer fibers diverge into the substance of the gland, and form a figure-of-8 network around the prostatic ducts. This serves to give each a distinct sphincter, and offers an effectual method by which it may be kept closed. Interspersed in this network are other fibers, which are circularly disposed; these are most numerous on either side, and posteriorly; in front, only a few are present. From these circular and longitudinal sheaths above mentioned, fibers radiate into the larger septa, where there they form a rich plexiform network; and in turn send finer fibers into the connective-tissue framework, between the cells. With the oil immersion these fine fibers are seen to be in relatively large numbers, and in some places to extend directly into the membrana propria. They are disposed for the most part in a circular direction around the alveoli.

The capsule is stated by most authors to be very rich in elastic tissue, but in the dog I have found quite the contrary to be true. In the muscle, a relatively large quantity is present, but in the capsule proper, it is sparsely scattered.

The anterior and posterior masses of connective tissue between the hemispheres is moderately rich in irregularly disposed fibers, which are in connection with those in the gland.

Caput gallinaceum.—In this organ there is a circular ring of fibers about the utricle, which extends downwards, and encircles the glandular substance more or less completely. Just underneath the mucous membrane, there is placed a crescentic layer of circular fibers; this is thinner than the former, and extends from base to apex. Encircling either ejaculatory duct is a denser circular sheath, which is partially blended with the above layers in the apex of the organ; but in the base it is entirely separate. In the base of the verumontanum, there is a projection upward of the longitudinal coat of the urethra; but not to a greater degree than on the lateral urethral folds. It appears, therefore, that in favorable sections the organ would present the appearance of containing a large quantity of the tissue, but in reality much of it belongs to the ejaculatory ducts and urethra.

In man the proportion in the organ itself is very much greater than in the dog; the coats above described are decidedly thicker and denser, and form over one-half of the entire stroma of the organ.

In the new-born baby there is a beautiful oval-shaped sheath surrounding the prostatic vesicle. Posteriorly, and at the sides of this, is a mass of longitudinal and circular fibers, which pass outward among the beginning ducts.

In castrated swine the elastic tissue almost entirely disappears. The same is most probably true of all animals.

Ejaculatory ducts.—These are encased in a dense coat which increases in thickness as the openings are approached; this is distinct and separate in its course through the prostate, from the elastic tissue belonging to that organ.

It should be remarked that, as the gland contains such a number of blood-vessels, some of the threads might have belonged to them. Care was taken in the examinations to exclude this error as far as possible.

In *puppies* the same arrangement was present as in the full-grown dog; the number, however, was much smaller, especially in the glandular portion.

In the *adult man* a similar disposition is seen to that in the dog; one difference is noted in the fact that the fibers in the glandular substance are more aggregated under the basement membrane, and probably a greater proportion lie in it.

In the membranous urethra the fibers are nearly all longitudinal; those at the neck of bladder are circular and oblique.

In the female urethra in this region, they are for the most part longitudinal.

PROSTATIC GLANDULAR SUBSTANCE.

The glandular elements, according to Mihálcovicz, are developed from the urogenital sinus; and the organ should be looked on as a highly organized urethral gland. This view I cannot accept; for it must be remembered that the Wolfian duct has its mouth immediately in this region; and it is therefore extremely difficult to differentiate the beginning ducts, whether they come from the one or the other. More-

over, the stroma, in part, originates from the genital cord, which surrounds the Wolffian duct; and the after-function proves beyond question, that it belongs to the generative, and not to the urinary organs. I think, therefore, it is most probable that the epithelium is an outgrowth of the Wolffian ducts; as are the testes, vas deferens and seminal vesicles.

The glandular substance is arranged in from 40 to 50 lobules, which are imbedded in a dense connective tissue, and surrounded by a beautifully placed muscular layer. It presents, in every sense, the character of a definite and compact gland, and is not, as asserted by Handfield Jones, "a number of scattered mucous tubules rather than a gland proper."

The lobules, as has been studied by Regnauld, and as I have observed them in the human embryo and new-born dog, project into the surrounding tissue as straight tubes. As the animal grows these give off branches from the sides, which divide again and again, until very complex lobules are formed. At first they are incorporated in muscle, but as they grow very much more rapidly than the latter, they pass beyond, and lie in the connective tissue. The muscle, later, extends itself and envelopes them. This is in striking contrast to the view held by Ellis, who affirms that "the glandular elements are only large urethral glands, which project among the urethral muscles." The tubules do not extend into the muscles, but, on the contrary, the muscles grow out into the gland.

The lobules are built on the alveolar type; are of a long conical shape, with the base toward the exterior, and the apex to the urethra; they measure across the base about 3 mm., and from base to apex one to one and a half cm. The base and sides are imbedded in connective tissue and muscle, as has been described. In the active stage, owing to a multiplication of their cellular elements, they are increased in size. From 5 to 7 lobules are placed in the longest longitudinal diameter, and 4 to 6 in the corresponding vertical; thus making from 25 to 30 lobules on either side.

The alveoli are relatively large, saccular in form, and have a diameter of 0.15 mm.; they permit a distention of twice or three times that size; toward the urethra they become smaller and less distensible. Five to seven are attached to a single duct; this empties into a larger, which in turn enters a still larger channel, until finally 3 to 5 main trunks are formed. These course toward the urethra, and unite, forming a common duct, about one to two mm. from the mucous membrane. In the posterior division of the gland the arrangement is different; there 4 to 6 lobules empty into the same duct, which penetrates the side of the verumontanum, and opens about 1 mm. behind the ejaculatory ducts.

The ducts, 30 to 40 in number in the dog, are about one mm. long and one-sixth mm. in diameter; they have no distinct coat of their own, but are surrounded by the dense connective tissue forming the urethral wall, and a special set of elastic fibers previously noted. They empty over the whole circumference of the prostatic urethra; the mouths are for the most part on a vertical plane with or behind the caput allinaeum; only a few are situated in front. In man, the

openings are mostly confined to the urethral floor, and number, according to Svetlin, from 15 to 32.

I have observed by a careful study of a number of serial sections, and by sticking fine objects into the mouths of the ducts, that they all open in such manner as to eject their secretion directly towards the mouth of the ejaculatory ducts. In the dog those that empty in front are directed backwards. This I consider extremely significant, and, so far as I know, it has not been previously observed.

Gland cells.—These have been studied by Rudinger and Langerhans in man; by Stilling in the rabbit, and by Griffiths in the active and passive stages of the hedgehog and mole. My description will be confined to the dog; with some observations, as obtained from the cat and hedgehog. Human tissue was also examined, but the preservation was not such as to warrant a study of the glandular substance. I am convinced, by many observations on animals, that unless this gland is fixed immediately after death the cells undergo very rapid changes; I think, therefore, that descriptions that have been made on the human gland do not represent, even approximately, the true condition.

The cells were fixed, and stained as previously stated. In the deeper parts, the cells rest on a distinct membrana propria, and are disposed in a single row; they are of the long columnar type, and vary in shape as they are closely or loosely packed together. In the former condition they assume very diverse shapes; polyhedral, very long columnar, pear-shaped, and sometimes triangular. These various forms were given as different types of cells by Langerhans, but I am sure that they were produced by pressure from the neighboring ones. No cell membrane is present; the free border was usually clear and distinct, but in some instances it was uneven and ragged; this condition was occasionally so exaggerated that the cell contents were directly continuous with the secretion in the alveolus. This was noted with different fixing agents, and it is a question whether it was the result of the fixation, or a bursting of the cell with discharge of contents; the material on the outside appeared identical with the cellular protoplasm. The protoplasmic border next to the adjoining cell was quite plain in specimens stained by Heidenhain's iron-haematoxylin, while by eosin and erythrocin it was not clear.

The protoplasm was in large amount; in the outer half, it was densely studded with deeply staining granules, between which it was lighter, but no definite spongioplastic structure could be made out; (this appeared identical with the secretion in the lumen). The inner half contained fewer granules, and among them there was to be seen a number of very delicate threads forming the spongioplastic network. In the immediate neighborhood of the nucleus, it was much clearer; and in some to such an extent, that it gave the appearance of a vacuole. Behind the nucleus—that is, between it and the basement membrane—the protoplasm was extremely scant, and in the very active stage none was discernible. In the same region, other cells were seen, which had probably dis-

charged their secretion; the protoplasm was less, and not so granular.

The nucleus is about the size of a red blood-corpuscle; it is situated at the attached end of the cell, and seems in some instances to rest directly on the membrana propria; it is very distinct, sharply circumscribed, strongly staining, and has on the outer border a definite rim. The substance presents one large, and several smaller, intensely staining bodies; they have a ragged outline and lie in an extremely delicate network of chromatin threads. In the beginning of the active stage, and in younger animals, the chromatin elements are plainer, and in not a few, definite karyokinetic figures could be noted.

In other portions of the lobule, the cells are low cuboidal, the protoplasm is small in amount, and nearly clear; the nucleus is proportionately smaller, and is situated in the middle of the cell. They present all the characteristics of a less active, or an almost inactive, stage of secretion. Where the alveoli are much distended, the cells are very much flattened; and in the hedgehog they form a thin, membrane-like lining. Golgi's method was used to demonstrate the cellular ducts, but none were discovered. Various stains were employed to show mucous cells, but all were unsuccessful.

Passing down toward the urethra, the cells assume a cuboidal shape; the protoplasm is less clear and not so granular. The nucleus is smaller, denser, and more deeply stained, and is placed near the center of the cell.

In the ducts the cells are much more flattened, the protoplasm forms only a small rim and is entirely clear; it surrounds a small, homogeneous, deeply stained nucleus. The lowest portion of the duct is lined by an ingrowth of urethral cells.

The secretion in the alveoli stains very deeply with eosin and picric acid; it contains small structureless flaky bodies, but no concretion.

In the half-grown dog, three to five layers of cells are present in all parts of the lobule. The under rows are flatly cuboidal, irregularly placed, and do not form definite layers; their nuclei are relatively large, and surrounded by a narrow rim of homogeneous protoplasm. The overlayer is made up of larger cells, rather more columnar-shaped, with a medium-sized, clearly defined nucleus; the protoplasm in the outer half shows a beginning granular appearance.

In the new-born child and dog many layers of cells are seen; in fact the whole lumen is nearly full. They are closely packed, flatly cuboidal in shape and have a very irregular outline. The protoplasm is extremely small in amount, and, in some, almost invisible; the nuclei are proportionately large, and appear as homogeneous deeply stained bodies.

In a hedgehog, which was examined in the height of the active season, the alveoli were thrown into numerous folds by cellular projections into the lumen. The individual cells were long columnar-shaped, with an irregular, not definitely circumscribed free border. The protoplasm and nucleus presented the same characteristics as those already described in the dog; the former was perhaps more granular and more deeply staining. I was unable to study the gland in the

winter season, and could not therefore observe the cells in the passive stage.

ADENOID TISSUE IN THE PROSTATE GLAND.

In the literature, no mention is made of the gland containing lymphoid tissue. In quite a number of prostates, bits of that tissue were scattered here and there throughout the substance. At first it was taken for round-cell infiltration, and not until toward the last of the work was its true nature determined. It is generally situated near the lateral surface. Two to three small nodes are usually together, with a rather thick layer of connective tissue between them. The nodes are surrounded by a thin sheath of fibers, which extend into the substance, and ramify among the peripheral cells; but do not penetrate far into the interior. In the specimens stained by Mallory, a very fine meshwork of extremely delicate fibers was discernible in the central parts. The cells are closely packed, and present the same appearance as lymphoid cells seen in other locations. Scattered in some of the nodes are minute channels, with extremely thin fibrous walls, and lined by endothelial cells; these are most probably lymph-vessels. Extending off into the prostatic substance are strands of connective-tissue, which form a kind of outside framework and support. The glandular prostatic tissue lies well up on the outside, being arranged as in other areas, and does not show any apparent connection with the lymph node.

Various methods were tried to inject the internal lymph spaces, but none proved satisfactory. With the superficial injections a few vessels near the periphery were filled—which did not look like blood-vessels—but were too few to give sufficient proof that they were lymph channels.

THE CAPUT GALLINACEUM.

This organ has been so well described by Henle and Rüdinger that it will be necessary to say only a few words in regard to it. Weber was the first to give an account of it; and in the works of many anatomists it bears his name; he thought it represented the uterus. Merkel, in 1848, promulgated the view that it had its homologue in the anterior portion of the vagina; which opinion has been accepted by Thiersch, Lilienfeld, Ratke, Mihálcovicz, and Tourneux.

The stroma, which consists of connective tissue, muscle and elastic tissue, has already been described. The glandular substance is situated near the apex; it is of an alveolated sacular form; has a moderately large lumen, and empties by a slit-like opening in the anterior portion of the crest. The cells are columnar shaped, arranged in a single row, and, in the active stage, show the same characteristics as the prostate, but to a less degree. The lumen is filled by a thin, slightly turbid alkaline secretion. After castration, as I have observed in the hog, the cells atrophy; and muscle and elastic fibers almost disappear.

It is asserted by many anatomists that this organ is functionless; but, considering the facts, that the glandular substance is made up of active epithelium, is surrounded by a thick muscle which serves to expel its secretion, and that

atrophy occurs after castration, I think it undoubtedly true that it furnishes a secretion which is necessary for the semen. The function of the hill will be fully discussed when speaking of ejaculation.

From the foregoing paper the following conclusions may be drawn:

First. The prostatic muscle is derived from the longitudinal coat of the urethra, and the circular layer of the bladder.

Second. Every lobule is surrounded by a circular and longitudinal coat, so arranged as to expel quickly and forcibly the secretion.

Third. The prostatic muscle of the full-grown animal is independent of both urethra and bladder, and is only indirectly in connection with either.

Fourth. The muscle is not so disposed as to compress the urethra, or to act as a sphincter to the bladder.

Fifth. The connective tissue is found in nearly the same amount as in other secreting organs; and is amply sufficient to give all the needed support to the gland, independent of the muscular elements.

Sixth. A membrana propria is present in all cases, and consists of very fine connective-tissue fibers. There is a sheath of longitudinal elastic fibers around the prostatic urethra, from which the outer fibers diverge around the prostatic ducts in a figure-of-8 manner, and thence onward into the glandular substance.

Seventh. Outside of the above named elastic coat is an incomplete circular set of similar fibers, which also pass into the glandular substance.

Eighth. In the gland substance a rich elastic mesh-work is seen lying under the cells, with a few extremely fine fibers in the membrana propria.

Ninth. The glandular substance forms about five-sixths of the organ.

Tenth. The cells are disposed in one layer; tall columnar shaped; have a large amount of protoplasm, and a well-defined nucleus. In the same lobule areas are present where the cells are entirely inactive.

Eleventh. Adenoid tissue is scattered at irregular intervals throughout the gland.

THE FUNCTION OF THE PROSTATE.

The opinions of physiologists respecting the function of the prostatic gland have been very diverse and contradictory; some have gone so far as to assert that it has not sufficient glandular function to warrant the use of the term gland. Others claim, that as a gland, it fills a *very* important office.

Wagner was of the opinion that in some of the lower animals, it, in connection with the vesiculæ seminales, secreted fluid, which was ejected into the vagina after the semen, and prevented the former from running out.

Ellis thought its main function was muscular, being that of expelling the semen into the forepart of the urethra; and that its glandular nature was very insignificant.

Harrison affirms that its chief rôle is to act as a support, and a sphincter to the bladder.

Handfield Jones asserted that "it should not be looked at as a gland proper, and that its part in generative function was not to add any essential element to the fecundating fluid, but merely to appropriate a viscid material involved, in which spermatozoa may be securely transported on their destined route."

Chapman states that the function is not known. Herman, Hensen, and others are of the opinion that the gland, in connection with other accessory glands, serves to give the motility to the spermatozoa.

Steinach, in a very careful and painstaking work, found that after extirpation of the seminal vesicles in rats, their fecundating property was very much decreased; and that with extirpation of both seminal vesicles and prostate, it was brought to nil.

Fürbringer gives a very interesting account of a patient suffering from spermatorrhea; the semen passed without sexual excitation contained nearly immotile organisms; while in that ejaculated during the sexual act, they were very lively and active. He thinks the change was due to a mixture of prostatic fluid; and concludes that the function of the organ is to give a secretion, that stimulates the movement of the animalcules.

In order to elucidate the subject more clearly, it will be necessary to say something respecting the motility of the spermatozoa. It is stated by nearly all anatomists that in the testis, the organisms are immotile or nearly so. Hammar found that in the epididymis, nearest the testicle where the semen was thick, there was no motion; but toward the beginning vas, owing to glandular secretion, the fluid became thinner, and a part of them were somewhat motile.

In the ejaculated semen, they are all motile; it appears, therefore, without doubt, that they must meet some substance on their outgoing, that influences their motility. In order to determine this, various experimentation has been done. Thus Kölliker found that they moved freely in lymph, blood-serum, weak alkaline solutions, &c.; while they were brought to a standstill by gums, dextrin, mineral salts, weak mineral acids, &c.

Herman and Gruenhagen affirm that the movement is lively in the secretion of the accessory sexual glands.

Steinach observed lively motion, in a mixture of normal salt solution, with semen taken directly from the testicle; but it came to a standstill in three hours. A second mixture was made with prostatic secretion; in this there was seen a very lively motility, which continued for twenty-one hours.

In order to throw still more light on this subject, a series of experiments was instituted, the results of which will be given in the following:

The dogs were killed by a blow on the head; the testes and prostate were removed and laid in a warm, moist oven. The microscopic examination was made on a Ranvier warm stage, which ranged between 37 and 38° Cel.; and every care was taken to make the work as nearly faultless as possible.

The semen was first examined alone, from the testicular

substance, globus major, globus minor, and vas deferens; secondly, with a mixture of prostatic juice; and thirdly, with normal salt solution.

We found: First. In the testicle itself there was no movement.

Second. In the globus major, no motility.

Third. In the globus minor slight movement of a few organisms, where the fluid was thin.

Fourth. In the vas deferens, slight motion in the portion where the liquid was thin; in the thick parts, which composed the largest bulk, there was no movement.

Fifth. In a mixture of prostatic juice and semen from the substance of the testicle, there was distinct, but not lively, motion.

Sixth. Semen out of the epididymis with prostate juice showed lively motility, which continued unabated for some time.

Seventh. Semen from the epididymis with normal salt solution gave lively movement, in the places where a mixture had occurred. In other areas where the liquid was thick, no motility was apparent. The same was also true of the prostatic mixture.

We explain the production of the immediate movement by a thinning of the fluid, and not by a distinct stimulating influence of the prostatic juice. The latter may also exist, but, from the following observations, we think the thinning is sufficient:

First. In the testicle and globus major the fluid was very thick, and no movement was seen.

Second. In the globus minor and vas def. a part of the fluid was thinned from the secretion of the epididymis; in this part alone was movement noted.

Third. After mixture with the prostatic juice motility was seen only where the semen was thin.

Fourth. After the addition of the salt solution the same was seen as with the prostatic secretion.

For the continued motility more is necessary than the mere thinning; for in the salt solution, all movement ceases after three hours; whereas, in the prostatic juice, it continues over 20 hours. (Steinaeh.)

From the above the following conclusions may safely be drawn:

First. That the immediate production of motility of the organisms is induced by a thinning of the testicular secretion with the prostatic juice.

Second. The continued movement is probably kept up by substances in the prostatic fluid, that either act as stimulants or as food for the organisms.

Third. Unless a homogeneous mixture is made, thick portions remain, where there is no movement.

Fourth. We take it, therefore, that, as the dog has no seminal vesicles, and the gland of Cowper is very insignificant, the function of furnishing a fluid, in which the spermatozoa can freely move, belongs entirely to the prostate gland. It then becomes apparent that the organ is almost as important as the organisms themselves.

EJACULATION.

The view was first promulgated by Weber, and has been accepted by nearly all anatomists since, that the *caput gallinaeum* became intensely congested during coitus, and prevented the back flow of semen into the bladder. In a perusal of the literature I have not found this contradicted. But in the course of my work on the prostate gland, I have become convinced that the idea is erroneous; the grounds for which are set forth in the following:

First. The verumontanum is not situated in the posterior portion of the prostatic urethra, but in the middle and anterior portions; so that, if the swelling was sufficient to block the urethra, it would obliterate the whole cavity.

Second. The caput gallinaeum is in the most capacious part of the prostatic urethra. It is not probable that an organ which was to act as an obstruction would be placed in a position which was most unfavorable for the performance of that function.

Third. The urethral fold covering the organ is as vascular as the others; but the substance of the organ proper is much less so; and in several cases, pointed out by Rüdinger, it was very deficient in blood-vessels. It is, therefore, not vascular enough to produce the necessary swelling to strongly obliterate the urethra at this point.

Fourth. From the crest it gradually slopes toward the membranous urethra, forming the crista urethralis anterior, and does not end more or less abruptly, as would be expected if it were intended to act as a valve. It is thus in a very poor mechanical condition to offer resistance, even if it were forcibly pressed against the anterior wall.

Fifth. The ejaculatory ducts empty on, or very near, the crest of the elevation; most of the prostatic ducts pour out their secretion opposite or behind it, so that if it were sufficiently enlarged to obliterate the urethra, it would entirely close both prostatic and ejaculatory ducts.

Sixth. The corpora spongiosa, in the anterior portion of the urethra, offer the same kind of resistance; and to nearly, if not altogether, the same degree as the verumontanum. The congestion is even greater in the penile portions, for the venous return is prevented by muscular contraction.

Seventh. In the hedgehog and cat the organ is placed considerably forward in the urethra; and between it and the bladder the urethra is narrow, and surrounded by a thick muscular coat, which offers all the necessary resistance.

Eighth. A cast taken of the distended urethra shows the organ pushed into the anterior portion and it is, relatively, a very insignificant elevation.

Ninth. An artificial erection was made by forcibly filling the blood-vessels of penis, prostate, and bladder. During this, a low melting paraffin was injected into the urethra; under very slight pressure it passed directly into the bladder. After the bladder was quite full, the pelvis was cooled, and laid in strong muriatic acid, until the flesh was removed. The cast thus obtained showed a moderately capacious prostatic urethra, with the verumontanum extending not more than half way to the anterior wall.

Tenth. During the highest point of an erection, micturition can be accomplished, although not with the same force as otherwise, but this fact proves conclusively that the urethra is not occluded. This point has been noted in the insane and I have personally observed it in other cases.

Eleventh. It may be argued that the prostatic muscle contracts, narrowing the urethra, and thus aiding in the occlusion of the canal. This cannot occur to a material degree, for the muscular arrangement is not such as to permit it.

The above is, I hope, sufficient to throw some doubt on a generally accepted theory, which I am convinced is erroneous.

Next will be considered the mixing of the semen and prostatic fluids, and the ejaculation of the same.

It has been shown, in what has been said of the prostatic function, that in the testes and epididymis, the vast majority of the spermatozoa were motionless, and that by a mixture of the semen with prostatic secretion they became distinctly motile.

It appears, therefore, absolutely essential for a mixture of the two fluids to occur; otherwise the organisms remain unable to move, and consequently not capable of producing fecundation. It was also noted that unless the mixture is perfectly homogeneous, large numbers of the organisms remain in thick portions of the fluid. As the semen is a thick, tenacious fluid, more or less mechanical means are necessary to produce a proper incorporation.

It can, therefore, be asserted that, first, a mixture of the two fluids must be brought about; and, second, that the union must be homogeneous.

We will now return to the anatomical arrangement, and see how this occurs.

The ejaculatory ducts always empty on the crest of the caput gallinaceum and the prostate by from 30 to 40 openings in the wall of the urethra. These facts have been noted by all anatomists, but no significance has been given to them. This arrangement, I shall attempt to show, is of the very highest importance.

The prostatic ducts, as I have seen by study of serial sections, and by sticking fine objects into the mouths of the ducts, all converge toward the caput gallinaceum, and are directed so as to eject their secretion toward the openings of the ejaculatory ducts. The two largest are situated just behind the mouths of the ejaculatory ducts, and throw their secretion in the same direction as the others. Thus, as the semen is being poured out, 30 to 40 streams of prostatic fluid are ejected into it. It now becomes apparent why the ejaculatory ducts open on this eminence; namely, to be in a position so that the ducts from the floor, sides, and roof, posterior and anterior, can reach it. We have in this way a most beautiful anatomical arrangement for forming a perfectly complete mixture of the two fluids.

I think, therefore, that the main function of the prominent eminence of the verumontanum is to afford a hill on which the ejaculatory ducts can empty.

If we revert to the muscle, we see that every lobule is sur-

rounded by a relatively strong muscle; so disposed as to expel the lobular contents quickly and forcibly.

Thus, without physiological proof, we have an anatomical arrangement which proves the fact that it is necessary for a thorough mixture to be made.

It is now left to consider the expulsion of the fluid; before doing this it is necessary to glance at the muscular arrangements; namely, the sphincter of Henle, and the sphincter membranaceæ urethræ. The last named commences, we will say for convenience, at the outer portion of the urethral half of the prostate, and extends along the urethra, encircling the membranous and part of the bulbous divisions, and ends about the middle of the anterior half of penis. In man and dog, it is from 0.3 to 0.8 cm. in thickness; at the beginning it forms a bridge between the two sides of the gland, and is inserted into the connective tissue between the lobes. Immediately ventralwards it is thickened, and forms the so-called sphincter of Henle; which was supposed by him to act as sphincter to the bladder. This idea has been accepted by most anatomists, while others, notable among whom are Sappey, L. Testut, and Griffiths, have disputed it. The chief office of the remaining portion of the muscle is thought by quite a number of authors to be that of keeping the bulbous urethra closed, and accelerating the flow of urine. Henle, Frank-Martin, Hunter, Sappey, L. Testut, and Griffiths, were of the opinion that it was mainly connected with seminal organs, and aided largely in the expulsion of the semen.

First, in regard to the external sphincter of Henle, I am of the decided opinion that it does not act as a sphincter to the bladder; the grounds for which belief are set forth in the following:

First. The bladder is provided with a circular sphincter at its neck, which is amply sufficient to hold the urine.

Second. In the female no such muscle exists. If it were necessary as a sphincter, it would certainly be more needed by women, where the urethra is much shorter, and the bladder is dragged about by the uterus.

Third. As the prostate gland is between it and the bladder, urine would be permitted to enter the prostatic urethra, and would be stopped over the orifices of the prostatic and ejaculatory ducts.

Fourth. In the cat and some other animals, as first pointed out in this connection by Griffiths, it is removed quite a distance from the bladder, and could not act as a sphincter.

Fifth. In serial sections of the prostate and membranous urethra I found in every instance that the portion of the canal which was surrounded by that muscle was wide open, while the neck of bladder was closed.

The remaining portion of the muscle is no doubt concerned in the phenomenon of micturition, but that its chief work lies in that direction is very questionable. It was first pointed out by John Hunter that in castrated animals, this muscle becomes white, fibrous, and nearly functionless. Later, Griffiths confirmed these observations, and extended the research to other animals, which had a distinct rutting period.

In the castrated animals he found the muscle tough,

fibrous, and ligamentous; in the quiescent stage of the others, it was atrophied, contained a large amount of fibrous tissue, and had lost very largely its cross striation. I have observed the muscle in castrated hogs, and found it atrophied to a certain extent, but not to such a degree as seen by others.

Now, to return to the ejaculation; the semen is ejected forcibly into the urethra in the direction of the membranous (urethra) part. It does not pass backward into the bladder; first, because the manner by which it is ejected gives it a forward impulse; second, the neck of that viscus is closed by its own sphincter; and, third, the anterior part of the urethra dilates, and draws the fluid forward.

As the semen is being poured out, the longitudinal fibers of the sphincter urethra contract and dilate the caudal half of the membranous, and a portion of the bulbous, urethra; this produces a large cavity, and the semen rushes in to fill it. When this is accomplished, the contraction extends to the end inserted into the prostate and draws the lobes together, thus compressing the prostatic urethra, and closing the orifices of the prostatic and ejaculatory ducts. The wave proceeds to the thick portion of muscle, immediately in front of the gland, and closes the urethra at this point; it will be remembered that here is the narrowest part of the canal, so that in this region a pressure that would hardly close the bulbous division, will strongly obliterate the whole canal; we see also that the muscle is thickened in this place. Here we have the sphincter that closes the urethra and prevents the semen from going back into the bladder. Therefore the so-called sphincter of Henle, which is in reality only a part of the sphincter membranacea urethrae, is not a sphincter to prevent the urine from going out of the bladder, but one to hinder the semen from going into it. The semen is now expelled from the urethra by the continuing contraction of the anterior part of the muscle, together with the bulbocavernosus, ischiobulbosus, and a part of the constrictor redi penis.

During later stages of the ejaculation, the prostatic and ejaculatory ducts remain closed, in the manner previously described. The muscular contraction in the vas deferens, seminal vesicles and prostate is probably kept up, thus putting the contents of the respective organs on extreme tension; so that at the moment of relaxation, the fluid rushes out and furnishes material for the second part of the ejaculation.

The above, on first sight, appears to be a long process composed of several stages, but this, in fact, is not the case. The semen runs into the anterior portion, directly after it enters the canal; the muscle then contracts, closing off the bladder, and expels it from the urethra.

It is impossible to subject this to experimental proof; and it is simply put forth as a probable theory, in the light of the anatomical arrangements.

NOTE.—I was not able to observe the gland in the quiescent stage; but examined it in castrated hogs, and found a moderately thick muscle which, macroscopically, did not appear fibrous; and on microscopic section the fibers were well developed and presented a distinct cross striation.

Although the muscle is chiefly connected with the sexual function, it is not to be expected that it will lose entirely its

The conclusions that may be drawn from the above are the following:

First. The verumontanum does not prevent the entrance of semen into the bladder.

Second. The semen is prevented from passing backward into the bladder, by the contraction of the so-called sphincter of Henle.

Third. The prostatic ducts are so arranged that they eject their fluid directly into the outpouring testicular secretion, thus producing a homogeneous mixture.

Fourth. The longitudinal fibers of the sphincter membranacea urethrae dilate the outer half of the membranous, and a portion of the bulbous, urethra; and by this means draw the semen from the prostatic portion.

Fifth. During the last act of ejaculation, the orifices of prostatic and ejaculatory ducts are closed, and their respective fluids put on much tension; so that at the moment of relaxation, a sufficient quantity of semen is poured in for the next emission.

Sixth. The sphincter membranacea urethrae aids, not only in carrying the semen along the urethra, but helps very materially in expelling it.

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histological structure after castration, for the part it plays in micturition requires it to be active.

It is difficult to understand how a muscle, which, according to Griffiths, was "tough, fibrous, ligamentous, and had lost nearly all its cross striation," could be strong enough to act in obedience to the will, and check the flow of urine, during micturition. Such a function, he acknowledges, it possesses.

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A PIN IMBEDDED IN THE RECTUM.

By OTTO G. RAMSAY, M. D.,

Associate in Gynecology, The Johns Hopkins University.

Foreign bodies are not uncommonly found located in different portions of the alimentary canal, and such small objects as pins, tacks or fish-bones, which are easily swallowed, and which from their size and shape pass easily through the ileocaecal valve, are not infrequently removed from the rectum. The following case of foreign body is of interest, not so much from its rarity then, but because of the peculiar way in which the pin was imbedded in the rectal wall.

The patient, E. W., widowed, age 55, came to me on Dec. 2, 1899, complaining of a feeling of pressure in the rectum, of general malaise, and of having passed blood with the stool on several occasions. On careful questioning the patient stated that she had been troubled with some vague abdominal discomfort for about 5 years, though she did not attach any importance to her symptoms, as they were but slight. I do not believe they had any connection with the passage of the foreign body through the intestinal canal. Two weeks before coming to me she was suddenly seized with sharp pain in the rectum, and constant rectal tenesmus. This pain was stabbing in character, most severe when she exercised, or when the bowels were moved, but always present as a dull ache even when she remained perfectly quiet. She had seen traces of blood in the stools on several occasions, and had suffered one slight hemorrhage from the bowel.

Examination revealed normal external and internal genital organs. On introducing the finger into the rectum a wire-like body was immediately felt, projecting across its lumen, about $1\frac{1}{2}$ cm. within the anus. This, on more careful examination, proved to be a pin with its head buried to the depth of 5 mm. in the lateral wall of the gut, the point being free and impinging against the opposite wall. The rectal mucosa in this area was somewhat thickened from the constant irritation of the sharp point, and a free sanguino-purulent discharge covered the finger when it was withdrawn from the bowel. Slight induration of the rectal wall around the point of penetration of the pinhead was felt, but no signs of abscess formation could be made out.

The pin was easily removed by introducing a pair of forceps into the rectum guided by the finger, seizing the point to prevent its wounding the mucosa, and dragging the head from its bed in the rectal wall. The whole operation required but

a few moments for its completion, and caused but little pain. It was not necessary either to use an anæsthetic or to dilate the sphincter, as the foreign body was so close to the anus, and though some little pain was caused by the manipulation, it was not by any means unbearable.

The after-treatment consisted in frequent irrigations of the rectum with warm normal salt solution, and regulation of the bowel movements. This treatment gave complete relief to all the symptoms, and an examination two weeks later revealed a normal condition of the tissues.

A case of this kind is interesting chiefly from the difficulty in determining how the pin could have reached this position, and afterward have become imbedded in such a way in the rectal wall.

Four methods may be imagined by which foreign bodies can enter the rectum. First, they may be swallowed and traverse the intestinal tract to the rectum; second, they may be introduced into the rectum through the anus; third, they may enter the rectum by ulceration through its wall, from surrounding tissues or organs; and fourth, they may be formed in the intestine (enteroliths).

In my case the third avenue of entrance can almost certainly be thrown out of consideration, as the patient was perfectly certain that she had never stuck a pin into herself; and if a pin had penetrated any portion of the body deeply enough to remain imbedded in the tissues, she would certainly have been cognizant of this fact.

This leaves but two methods by which the pin might have reached the rectum, and it is more probable that she swallowed it, rather than introduced it through the anus.

That it is not an infrequent occurrence for pins to reach the intestinal tract in this way is shown in an article by J. F. Mitchell, appearing in the Johns Hopkins Bulletin of Jan.-Feb.-March, 1899, entitled "The Presence of Foreign Bodies in the Vermiform Appendix, with especial reference to Pointed Bodies," in which he describes a number of cases of pins and other like bodies in the appendix. Since the appearance of this article, several like cases have been reported, and in all of them the pin was evidently swallowed, as it would be impossible for it to reach the appendix in any other way.

The same fact is proved by the number of other foreign bodies found in the rectum—fish-bones for instance, which are certainly swallowed. Goodsall ("Notes on 20 Cases of Foreign Bodies in the Rectum," St. Bartholomew's Hospital Reports, Vol. XXIII, 1887, p. 71) reports twenty cases which he saw personally; in this number a fish or other bone was present nineteen times; a pin, once.

It is easy to conceive how a pin might be swallowed when the habit so frequently indulged in by women, of holding pins in the mouth while fitting a dress, is considered, and the ease with which it slips down is evidenced by numerous examples of the so-called "human ostriches," exhibiting in circus and vaudeville performances, who swallow with apparent ease nails, hairpins, chains, glass and other comparatively large bodies. A pin might also fall from the dress into the food and be swallowed without consciousness of the fact, and this is probably the way in which my patient became possessed of her foreign body.

From a consideration of the general character of foreign bodies removed from the rectum, with the history of how they reached this organ, we may conclude that the bodies introduced into the rectum through the anus are commonly of large caliber, and usually not sharp, while those entering the rectum from above are apt to be small and elongate in shape. This rule points in my case to the entrance through the mouth, rather than to its introduction through the anus.

How the head of the pin became imbedded in the bowel wall while the point remained free is a more difficult question to answer. It seems probable that, as the pin was forced down by the peristaltic movement of the bowel, imbedded in fecal matter, the head in some manner became engaged in one of the rectal pouches. We might suppose, then, that the pin would lie against the rectal wall, the head downward and the shaft extending upward parallel with the intestinal lumen. Sooner or later ulceration would occur, and the head become buried in the mucous membrane; after this had occurred the passage of a hard fecal mass, or a violent peristaltic contraction, would force the point downward across the lumen of the bowel, when the acute symptoms would begin.

That the point of the pin, instead of the head, did not become imbedded in the rectal wall seems to be only a matter of chance; if this had occurred, it is reasonable to suppose it would have penetrated the tissues more deeply, and a perirectal abscess would have resulted. Goodsall (*l. c.*) speaks of a case in which an abscess formed around the pin, giving rise to a blind internal fistula. In this case the head of the pin had penetrated the rectal wall, as on operation the pin was found projecting into the rectal lumen through the opening of the fistula.

It is not difficult to conceive why, after passing through the whole intestinal canal safely, probably imbedded in a mass of fecal material, it should have caught so close to the anus, as it can be explained by the narrowness of the anal opening, when compared to the rest of the intestine. Goodsall concludes from the study of his twenty cases "that the site of the puncture is within the last inch or three-quarters of an inch of the rectum." This situation may be explained

in all of the cases by a transverse position of the foreign body and the comparative narrowness of the anal opening.

The length of time required by such a body to traverse the intestinal canal cannot be determined from the history given by my patient. Goodsall, from studying the previous histories of his cases, states that the time varies between one and nine days, and from the comparatively clean appearance of the pin in my case, probably about the same amount of time was required.

The immediate treatment was perfectly simple, consisting in the introduction of a pair of forceps guided on the fingers, and the localization and extraction of the pin without previous dilatation of the sphincter ani, or the use of an anesthetic. Goodsall found it necessary to have recourse to a general anesthetic in quite a number of his cases, though it is to be noted that more than half of them were suffering either with an abscess or fistula when they came under his care.

The after-treatment consisted of frequent irrigation of the rectum with normal salt solution, which gave immediate and complete relief to all the symptoms. In case this had not given the wished-for results, mild antiseptic irrigations, consisting of thin starch-water, containing boracic acid, extract of hamamelis, or other mild antiseptic, would have been used, as we have found all of them quite efficacious in treating proctitis.

The appearance of a localized abscess in the rectal wall or in the perirectal tissues was closely watched for, but there were no signs of any trouble of this kind. Goodsall concludes "that when an abscess follows the puncture it begins to form within two or three days of the puncture." While this may be considered as a general rule, my case is an exception to it, as the patient had suffered with the acute symptoms for two weeks before coming to me. As a curiosity in this connection, I can also quote a case reported by W. Dutton Akers ("Pin in the Rectum for 30 Years," *Lancet*, 1898, Vol. II, p. 690), in which the patient had suffered for about thirty years with pricking pain in the rectal region on sitting down, constant desire to defecate, and pain on doing so. Besides this, the motions were small, pipe-like and streaked with blood. On examination, considerable induration and inflammation of the rectal mucous membrane were found. Above and to the right side of the internal sphincter, the head and half an inch of the body of a pin was felt, the head projecting upward and across the lumen. The pin was removed with dressing forceps, the removal being followed by rapid and complete cure.

An abscess or fistula is, however, probably the most frequent sequence, as Goodsall found in his twenty cases, three in which an acute abscess was present, while in ten there was either a blind or complete fistula.

If an abscess had been present it would have been freely opened, as is usual, and I wish to call attention here to the importance of thorough examination in all cases of abscesses, as several are reported in which the foreign body acted as an irritant, causing multiple recurrences.

In the case of a fistula, we have found it most satisfactory

to dissect them out carefully, after isolating the sphincter, close the bowel opening with catgut sutures after freshening its edges, and close the external wound with silkworm-gut. The precaution to search out and remove completely any branching fistulæ must be taken, as otherwise the wound will certainly break down.

A rapid healing will be noted after operation in these cases of fistulæ due to foreign bodies, with any form of operation, if the body is discovered and removed.

28 Elm Street, New Haven, Conn.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

JAMES J. MILLS, M. D. Retinitis Albuminurica.—*Maryland Medical Journal*, August, 1900.

W. W. FORD, M. D., PH. D. Chills in Typhoid Fever.—*Montreal Medical Journal*, July, 1900.

HUNTER ROBB, M. D. The Use of Rubber Gloves and Gauntlets as a Means of Preventing Infection in Surgery.—*Cleveland Medical Gazette*, August, 1900.

WILLIAM OSLER, M. D. An Address on the Importance of

Post-Graduate Study.—*Lancet*, London, July 14, 1900; *British Medical Journal*, July 14, 1900.

HENRY J. BERKLEY, M. D. The Pathological Findings in a Case of General Cutaneous and Sensory Anæsthesia without Psychical Implication.—*Brain*, Spring, 1900.

EUGENE L. OPIE, M. D. Pathological Changes Affecting the Islands of Langerhans of the Pancreas.—*Journal of the Boston Society of Medical Sciences*, June, 1900.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, June 18, 1900.

Report of Cases from Children's Clinic.

CASE I.—*Tuberculosis following Syphilis*.—DR. AMBERG.

The short history of the case is as follows: A very emaciated colored child, male, 16 months old, with a strongly specific family history, came to the Dispensary with polymorphous syphilitic eruptions of the skin, beginning to appear several months ago, and also with fissures in the lips and ulcers in the mouth, suffering besides with malnutrition and rachitis. The syphilitic manifestations yielded readily to a specific treatment. The examination of the lungs, when first seen, only gave the symptoms of inflammation of the larger bronchi, later presented signs of consolidation of the right posterior part of the lungs. Dr. Booker made the probable diagnosis of tuberculosis guided by the fact that an uncle of the child, living with the family, had died a short while ago from consumption. The disease progressed rapidly and a few days later the child died, 18 months old. The temperature never exceeded 102°.

That syphilitic children acquire tuberculosis is not rare and in this particular case all the circumstances—syphilis of long standing, malnutrition, rachitis, and very bad hygienic conditions—prepared a very favorable soil for the infection.

The post-mortem revealed a disseminated miliary tuberculosis. Lungs, pleura, liver, spleen, kidneys and mesenterium are full of miliary tubercles. The pleura had on

several places, particularly between the lobes, a thick fibrinous exudation. The trachea has in its lower part an ulcer whose sharply defined and not undermined borders do not show a very characteristic aspect, while lower down on the transition to the left bronchus is a more characteristic ulceration. The left bronchus opens immediately in a cavity nearly reaching the pleura. The bronchial glands are very much enlarged and the one cut open shows caseous degeneration. The rapidity of the course the tuberculosis assumed in this case, the formation of a cavity, the dissemination of the process and the great enlargement of the bronchial glands, make a picture which is not very seldom observed in children up to the second dentition.

CASE II.—*Diphtheria with Cardiac Malformation*.—DR. AMBERG.

The second child, white, male, 15 months old, was brought to the Dispensary after having suffered for two days with a croupous cough. On the morning it was taken with severe attacks of dyspnoea, the pharynx was reddened, but without pseudomembranes or patches. A smear made from material taken from the pharynx contained diphtheria-bacilli. Blood-serum inoculated from the same material gave positive results. Dr. Booker performed an intubation, which gave relief after a short time, but the breathing was not perfectly free. Besides, the child got an injection of 1000 units antitoxin. The child remained under observation for 6 days, in which it got 3 times 1000 units of antitoxin. The fever was never high, the pulse always fairly good. The breathing was sometimes

free, mostly difficult, and the tube, which was several times taken out, had to be reinserted, but failed in the last days to give relief to any large extent. The examination of lung and heart was very difficult, owing to violent movements of the chest and the excitability of the child, but a bronchitis extending down to the finer tubes could be detected. The heart sounds were covered by the coarse bronchial râles.

The post-mortem gave the following result: The lungs were edematous, partly emphysematous with areas of bronchopneumonia. The division into lobes is abnormal, the right lung presenting an additional lobe. In the trachea we see the remnant of a false membrane immediately underneath the vocal cords—and two ulcers, one where the tube touched the anterior wall of the trachea and the other further up on the same side, in the height of the cricoid cartilage, not so extensive as the first but of the same aspect and very probably due to the tube too. The spleen has a small additional lobe.

But the most interesting features we find in the heart. The enlargement of the heart is best seen in comparison with the heart of the first child, who was 3 months older. The heart of this older child has a foramen ovale, which is not perfectly closed, but the opening is not very marked and can be demonstrated only by help of a probe. On the right side of the septum in the direction of the vena cava superior is a small pocket formed on one side by the septum, on the other by a thin membrane. It is about 1 cm. long and on the opening about $\frac{1}{2}$ cm. broad. This opening looks downwards and its border consists of a muscular band. The other heart is enlarged as a whole, but the enlargement of the right side is preponderant. The walls of the heart are hypertrophic. Between the auricles is a wide opening crossed by several fibers coming from the posterior and superior walls of the auricles to the left of the middle-line and spreading fan-like to the anterior and inferior border of the foramen. The fibers are first muscular, but most of them become tendinous. The annulus interauricularis and the valvula foraminis ovalis, which form the secondary septum interatriorum are partly deficient, partly badly developed. The annulus interauricularis is running out in a muscular band, which you will see, holding the specimen towards the light, in the superior and posterior wall of the auricles. The origin of the above described fibers and what exists of the valvula foraminis ovalis is to the left of this muscular band. The valvula foraminis ovalis exists only in its upper part as a perforated membrane, showing the direction in which it should have been drawn by a few fibers. The opening is about the size of a silver quarter.

A remnant of the badly marked valvula Eustachii is to be seen in a fine ligament, running from the right side of the vena cava inferior to the also badly formed limbus Vieusseni. On the anterior wall, where the bulbus aortæ lies against the wall, are several muscular bands irregularly arranged, leaving small spaces between them, where muscular fibers are apparently wanting. There are no other irregularities to be noticed; the myocard and endocard seem to be in perfectly good order.

The occurrence of these large openings between the auricles without any other lesion of the heart is not frequent, as

Peacock stated, and as it is particularly emphasized by Fallot, who found in the reports of 10 years of the Bulletin de la société anatomique and Bulletin des Hôpitaux de Paris only 3 cases.

Two explanations are given for the malformations of the heart. One considers the malformation as a consequence of a foetal endocarditis, the so-called anomalies subordonnées. I think we can rule out the foetal endocarditis in this case, because there is nothing in the heart to justify this explanation, while the other irregularities found in lung and spleen lead us naturally to the other explanation and we may attribute the malformation to an arrest of development. Moussons is inclined to think, that perhaps too many cases have been ascribed to a foetal endocarditis, recalling Rokitansky's experience, who found that alterations of myocard and endocard are rare or little marked in very young or still-born children, while more frequent and better marked in older children or adults afflicted with malformation of the heart. Further, Moussons points out that the endocarditis may be secondary, an idea already brought forward among others by Rauchfuss, who states that a malformation may give a predisposition for a foetal endocarditis, explaining so that the foetal endocarditis is oftener found in the right heart.

I will give shortly the way in which Rokitansky tried to explain the malformation in question, when there is, as in our case, no stenosis of the pulmonary artery. He argues thus: While the septum interatriorum is formed the septum interventriculare is not yet closed. If there exists now a malproportion between the pulmonary artery and the aorta, so that the aorta is relatively too narrow, a part of the blood of the left ventricle will flow through the opening of the septum interventriculare into the right ventricle, causing dilatation and relative insufficiency of the tricuspidal valve. There follows dilatation of the right auricle and of the part forming the transition from the right to the left auricle and the dilatation is made responsible for the prevention of the perfect formation of the septum interatriorum. After the closure of the septum interventriculare the left ventricle will become dilated and the walls hypertrophic. As the cause of the narrowing of the aorta, Rokitansky regards a failure of development. Rokitansky does not claim that this explanation is always found valid, saying, that there are cases where the septum interatriorum was found closed under more unfavorable conditions. In our case the circumference of the pulmonary artery in the valvular region—the heart was preserved in alcohol—is 4.5 cm., that of the aorta 3.0, while the corresponding figures of the other heart are 4.2 to 3.0 cm. If this condition allows the explanation, Rokitansky's is very questionable. He thinks it is important that the septum is generally pushed to the left, an impression we get undoubtedly in our case, so indicating, that it yields to a pressure exercised from the side of the right auricle.

Several etiological factors are claimed to be important. Heredity is made responsible in several cases direct or indirect; syphilis, tuberculosis, rheumatism, pneumonia of the parents were suspected in others. Besides we find accused marriages between near relatives, rachitis and nervous

diseases of the parents. Of all these etiological factors none can be made responsible in this case. Another fact remains to be mentioned, the child was never blue before it was taken sick with the attacks of dyspnoea. This confirms again the observation of the authors, who found that even a wide opening between the auricles is not necessarily followed by cyanosis. Fallot particularly has noted that the malformation in question only exceptionally leads to the "maladie bleue." It is well known that a malformation like this is not a danger to life and it may allow even hard labor. That the malformation of this heart is in any way connected with the fatal end, is doubtful. Nevertheless, it is probable that the already much enlarged heart had not the power of resistance, like a perfectly normal one, and that it succumbed therefore more readily to the diphtheritic virus and the weakening influences of the bronchopneumonia.

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Thrombosis of Carotid Artery.

DR. CUSHING.—The patient was a colored man, 52 years of age, who came in last fall with the diagnosis of a tuberculous ulcer in the bladder. He was operated upon Dec. 30, a suprapubic cystotomy being performed with the patient in the Trendelenberg position. The ulcer was excised and the wound in the bladder closed as is usual when there is no particular infection of the urine and nothing to indicate the necessity for keeping the bladder open. He made a very good recovery from the anæsthetic and was left sleeping comfortably that evening. About midnight, however, Dr. Baer, who had him in charge, called me to see the patient, saying that he was stupid and dull. We found that he had a definite hemiplegia which we supposed was due to a cerebral hemorrhage. The left side of the face was completely paralyzed. The left arm was flexed and quite rigid, as was also the left leg. The respirations were Cheyne-Stokes in character. On the following day the whole left side became flaccid and he

presented the characteristics of a hemiplegic. The paralysis of the left side was complete, except for the supraorbital muscle. For twelve days he went on without change in the symptoms; the bladder healed up completely and we supposed the paralysis would also clear up. On Jan. 13 there was a sudden rise of temperature with pain in the back of the head and neck. Lumbar puncture was made and clear fluid withdrawn; no cellular elements present and no organisms detected. Forty-eight hours after this exacerbation paralysis of the cervical sympathetic was apparent and on the next day a pronounced swelling of the whole upper extremity began and extended over the chest. We supposed there was a thrombosis of the jugular vein and that possibly it had extended downwards from the cavernous sinus. The patient gradually failed and died that night.

The pathological findings showed a thrombosis of the carotid artery and almost the whole right hemisphere was involved in a white softening. There was no apparent arteriosclerosis noted clinically nor at the autopsy.

Whether his position at the time of operation could have had any predisposing effect I do not know, but I believe that such post-operative calamities are practically unheard of on the gynecological side where that position is so frequently used.

DR. PATON.—On inspection of the external surface of the right hemisphere it can be easily seen even that there is a large area of softening. This area corresponds to the distribution of the Sylvian artery, leaving out the superior temporal and the superior frontal convolutions. On the inner surface the region supplied by the anterior cerebral is very firm and apparently not involved. The posterior cerebral supply is not affected. It is evident that the whole carotid area is not involved, but only that part of it which is supplied by the Sylvian artery.

The microscopic examination of the tissues brings out some interesting points. Sections taken from the right frontal convolution show no trace of nerve cells, but in their place are great numbers of cells similar to those found in all softened areas. One does not care to say anything definitely concerning the origin of these cells as it is an old question of dispute. Without doubt the vascular system supplied some, and the neuroglia tissue, others. Then there is a cell element that I believe will sooner or later be shown to have an important relation to these conditions, and that is the indifferent cell which exists in such great numbers in the adult nervous system. Some of these cells may persist as indifferent cells through life and some may become neuroglia cells.

The cells in the motor area on the right side show only very slight changes.

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ERRATUM.

In Dr. Welch's article, p. 186 (Vol. XI) of the BULLETIN, line 5 of footnote 14, "constantly" should read "inconstantly."



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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

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Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otolaryngology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating-rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

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ANEURISM OF THE AORTA TREATED BY THE INSERTION OF A PERMANENT WIRE AND GALVANISM [MOORE-CORRADI METHOD].

WITH A REPORT OF FIVE CASES.

BY GUY L. HUNNER, M. D.,

Assistant Resident Gynecologist, The Johns Hopkins Hospital.

The study of the literature concerning aneurism of the aorta convinces me that this dreadful malady is usually a surgical disease. The authenticated spontaneous cures are sadly few in number. Clinical experience demonstrates that we can extend but little hope to a patient in proposing the palliative method of Bellingham¹ commonly known as the Lufnell² treatment. Moreover, this treatment, as well as its modification by the use of potassium iodid as proposed by Balfour,³ to be properly carried out, requires first, a patient of more than ordinary hardihood, and secondly, conditions with which it would be impossible to surround the average patient. With these facts before us, and a surgical measure at hand with which there is considerable chance for success it may be questioned whether we are justified in allowing these cases of aortic aneurism to go without operative interference.

It is impossible in a paper of this scope to enter into the merits of the various methods of treatment now in vogue, but we may be permitted a hurried survey of the subject. We are confining our remarks to aneurism of the aorta. For those aneurisms of the vessels of smaller and intermediate size easily reached by the surgeon, it is probable that the interior treatment by ligature will long continue the preferable method.

Ligation of the aorta, reported in ten cases⁴ as performed for aneurism, has been universally fatal, the patients living from 4 hours to 11 days.

Pringle⁵ refers to five cases of abdominal aneurism, probably all of the aorta, successfully treated by proximal pressure. Manifestly thoracic aneurisms cannot be so treated, and he recognizes the fact that most abdominal aneurisms arise about the celiac axis and cannot be treated by proximal pressure. Pringle would limit this method to those aneurisms which arise below the aortic bifurcation. He quotes results in five cases of abdominal aneurism treated by distal compression. Death followed in these cases from peritonitis, obstruction of the bowels, gangrene, and reduction of the pancreas to a pulp.

The method of Cinieelli⁶ of galvano-puncture or electrolysis was first suggested independently by Velpeau⁷ and by Benjamin Phillips⁸ and is still being used with more or less success, principally by the Italians. Another method in vogue in Italy is that of Baeceelli⁹ who introduces several steel watch springs into the sac and allows them to remain.

The only other surgical method worthy of consideration is that successfully practised by Macewen,¹⁰ of needling the inner lining of the sac and waiting for the thrombus formation

and, according to Macewen, organization. Given an aortic aneurism of small size with the three coats and their vasa vasorum, and this method offers some chances for cure. But the process requires from a few to 48 hours for the needling and from weeks to months for the thrombus formation, even in the most favorable case. Moreover, the strengthening of the wall takes place where the point of the needle plays rather than on the anterior wall, where, in aneurism of the thoracic aorta, at least, there seems to be the most frequent extension. Manifestly in abdominal aneurism only those cases which lie in immediate contact with the parietes could be so treated and the certain diagnosis of such a condition is quite an impossibility.

The brilliant results reported by the French¹¹ authors in the use of the gelatin method have not been confirmed in our wards. With Dr. Fletcher¹² we believe the method deserves further trial and would recommend it if a patient presents himself before being in a desperate condition. Dr. Finney suggests that future experience may prove the advisability of giving a few gelatin injections shortly before operation by the Moore-Corradi method.

In the year 1864 Mr. Charles H. Moore of the Middlesex Hospital first attempted the cure of an aortic aneurism by the insertion of a permanent foreign body.

That this hazardous operation was undertaken only after careful consideration of the principles involved, is evidenced by his observations: to wit, "the first indispensable condition for the cure of thoracic aneurism is to provide means of eliciting fibrin from the blood," and, "the second indispensable condition for relieving an aortic aneurism is to extend the surface within it on which fibrin may coagulate."

Nothing daunted by a failure in his first case, due to the then obscure agent sepsis, he says:—"if there be no manifest and essential fault in the procedure I cannot think it right to abandon an operation which was so promptly followed by the most marked and positive improvement. On the contrary, I regard its early results as strikingly confirming the main part of the theory and as affording for other cases a substantial promise of advantage from which future thought has but to eliminate the cause of ill success." And he suggested two very important improvements in technique; (1) that a less quantity of wire be used (he used 78 feet) and (2) that the wire be so manipulated as to insure its coiling in the cavity and not merely lying in circles against the walls.

Since Moore's failure the application of aseptic surgery has removed the greatest "cause of ill success" and the addition of electrolysis as suggested by Corradi has been a marked improvement in method.

Method.—While this operation was devised by an Englishman and modified by an Italian, it has been developed principally by Americans. And among these Dr. D. D. Stewart, of Philadelphia, deserves most credit for his activity in evolving a good technique.

In his preparation for an operation the surgeon should experiment beforehand with his needles, wire, and electrical apparatus, to find which he can manage with the greatest

facility and effectiveness. The needles should be considered with regard to size, material, insulation and sterilization. One chooses between the cannula with trocar, and the lance-pointed aspirator needle, which latter may be inserted alone or with the initial end of the wire already introduced. Within limits the needle should be large enough for the easy passage of the wire. The loss of blood, if the wire be inserted with the needle, or soon after, is very slight and most aneurism patients would probably be benefited by some bleeding.

As to insulation, the needle should be covered from the shoulder to within 1 cm. of the point, with some non-conducting material, so that the electrical current will not be dissipated when the needle passes through the sac wall. Duncan¹³ after trying glass, sealing-wax, varnish of various kinds, caoutchouc, and shellac, advised covering the needle with vulcanite; but hard rubber cannot be properly used without materially increasing the caliber of the needle. Our needles were covered neatly and effectively with a black varnish of lacquer. ("Best French Lacquer," made by Behlen & Bro. New York City.) This cannot be boiled nor will it bear soaking in carbolic. It softens in the steam sterilizer either with or without pressure but quickly hardens on exposure to dry air; so this method may be used. But the best method is to sterilize in a dry-air chamber. One should select a half-dozen needles of various sizes and lengths; have them lacquered; place them in a test-tube, and cork with cotton. This is placed in a hot-air chamber, the temperature raised to 160 degrees C., and allowed to remain there one hour. The test-tube is kept corked until time for the operation, when the needles are emptied out on a dry sterile towel or plate.

In selecting wire one considers the amount to be used, its size and its composition. The recognition of a few general principles will aid in its selection. (1) The disposition of the wire in the lumen of the sac is an important factor in the amount and effectiveness of the fibrin whipped out. A small quantity of fine wire possessing a good spring should be selected. (2) Cure of the aneurism demands as complete contraction as possible of the sac wall upon the clot formed at or soon after the operation. The wire should be of such amount and material as not to interfere seriously with this contraction. (3) The corrosion of the wire by the electrical current makes a rough surface very conducive to the rapid whipping out of fibrin. Within limits the wire most easily corroded is to be preferred.

One can gain many valuable points regarding wire and needles, and acquire a facility in their management by experimenting on a few glass flasks varying in capacity from 20 to 500 cc. and stoppered with ordinary corks. The needle is pushed through the cork, and the wire, after being wound on a spool and boiled as described in Finney's first case, is passed into the flask. It will be found that 10 feet of fine wire with a lively spring, effectually meshes the lumen of a 500 cc. flask. By reference to the literature we find that no more than 10 feet of wire were used in the successful cases. But we believe 20 feet might be used in some cases and Dr. Stewart is of the same opinion (see report of his fourth case).

Steel wire takes a better coil than pure silver, even after the latter is highly drawn. But steel is stiff for manipulation, as a high resistance, and, theoretically at least, would interfere with the contraction of the sac. Soft iron wire, as shown by the experiments of Stevenson,¹⁴ decomposes very rapidly under the electric current and, as demonstrated by Stewart, it is probable that the detritus given off would be a source of danger in the capillary circulation. The undrawn silver has scarcely any tendency to coil after passing the needle, and other jams from side to side as it meets the resistant glass walls, thus only partially getting into the lumen, or takes the loosest coil possible about the periphery. We have not worked with gold wire as used by Stewart and others.

After considerable experimenting in conjunction with Mr. Frank Persohn, who makes the wire used in the hospital surgical work, we found a silver alloy, highly drawn, to be quite ideal;¹⁵ 75 parts of copper to the thousand makes a wire which when drawn from No. 8 to No. 27 (standard gage) takes a looser coil than steel (see photograph). It is more pliant than steel, thus minimizing the danger of puncture should the end come in contact with the thin aneurismal wall. It has more body than the pure silver of equal drawing, and is therefore more easily passed into the needle without kinking.

Silver corrodes much more than steel, thus forming a rougher surface for the whipping out of fibrin. We believe, however, that the fibrin formation is far more a chemical than a mechanical process; and silver, being one of the least resistant of all metals to the electric current, transmits more of a given current for action on the blood.

With regard to electrical apparatus we have found the galvanic battery of the Baltimore Chlorid of Silver Dry Cell Battery Company a compact, simple and effective instrument. It rests on a small table near the anesthetist and by means of insulated conducting cords is connected—the positive pole at a long end of the wire from the aneurismal sac, the negative pole to a metal plate at the back. This plate should be well covered with several layers of towel kept moist throughout the operation.

Never should the sac receive both poles, nor should the current so passed that the negative electrode is in the sac. Duncan, and later Stevenson, in the papers above cited have shown that about the negative pole there accumulates "a yellow, gelatinous, alkaline, mass composed to a great extent of gas bubbles which very quickly break down." While about the positive pole "the clot is smaller, firmer, and darker in color, and shows an acid reaction."

Abbe by reversing the current toward the close of his operation probably softened the clot already formed by the positive current.

Experiments.—We wish to supplement these remarks on this method with the results of a few experiments made with the wire to determine the effects of the electrical current on dif-

ferent wires and on the blood. Taking to the abattoir two batteries and both steel and silver wire we had fresh hog's blood caught in two glass jars which had been thoroughly cleaned and vaselined. We were surprised at the almost instantaneous coagulation of the blood, but in spite of this phenomenon we had no difficulty in placing our wires. A coil to receive the positive current was pushed down into the center of the jelly-like mass, and the negative wire was carried to the bottom of the jar through a fine glass tube inserted at the periphery of the clot.

The batteries being connected, a current of 100 ma. was passed through each clot. The current through the steel wire remained practically constant for an hour, while towards the end of this time that through the silver wire grew less, as explained below. The action of the powerful current was immediately manifested about the negative wires where their ends projected from the glass tubing. Here there was a rapid formation of water, an active ebullition of gas bubbles, and finally a large excavation in the bottom of each clot.

At the end of an hour the rolls of coagula were slipped out of the jars and the wire coils examined. These showed a marked action of the positive current. The steel wire was surrounded throughout its length by a zone of adherent blackened material three or four millimeters in width. The wire was corroded and of slightly smaller caliber but still retained its form and resistant spring. The silver wire presented a more decided picture. The charred coagulum about the wire was of greater width than that about the steel wire, and the wire itself had suffered such corrosion that it broke easily in attempting to free the clot. We wondered why the galvanometer registering for the silver wire should drop during the last quarter hour from 100 to 50 ma., and here was the explanation in the reduced caliber of the wire.

To test the coagulating power of the electrical current we decided to try partial tying off of a dog's aorta at two different points, hoping thereby to get a slowing of the current and some dilatation between the points of partial ligature. Partial tying at the bifurcation did not cause appreciable dilatation above, nor was a sac imitated when another partial ligature was placed just below the renal arteries. The latter ligature was discarded and the lower ligature tightened to entirely close the lumen at the bifurcation. This caused an appreciable increase in tension and possibly some dilatation. A strong current was flowing because of the renal, ovarian, and numerous small lumbar arteries.

An insulated needle was inserted just above the ligature with its point toward the dog's heart and a number 5 (music gauge) steel wire easily inserted. The wire quickly perforated and we had to withdraw the needle and tie off above the perforation. We then loaded the needle to its point with a pure silver wire (drawn), of the same size (No. 27 standard gage), and inserted the needle to its hilt. This carried the wire above the renal arteries where it was left by simply slipping the needle back to its point of entrance. With the positive pole connected with this wire and the negative to a large metal plate under the dog's shoulders a current of 50 ma. was

¹⁴This work was done immediately after Dr. Halsted's case in the winter of '97-'98. Reeve shortly afterward experimented with various kinds of wire and arrived at the same conclusion with regard to the propriety of the silver alloy.

passed for ten minutes, then a current of 65 ma. for ten minutes, increasing to 80 ma. and keeping it there for twenty minutes. At the end of this 40 minutes the wire could be felt distinctly larger. The current was stopped and the dog quickly killed with the anæsthetic. On dissecting out the aorta from the diaphragm to the bifurcation and opening it the wire was found to be covered by a coating of reddish yellow fibrin, varying from 1-2 mm. in thickness. This was rather firmly adherent to the wire, coming off in strings when pulled away. The wire was considerably corroded, fine bits of silver coming off with the fibrin and more being scraped off with the finger nail.

Being convinced by various observations that the current generally used is stronger than necessary and even dangerous (see autopsy report, Dr. Finney's first case) I tried in a dog's aorta the effect of a 20 ma. current for an hour. This caused apparently the same amount of coagulum as described in the foregoing experiment, but possibly the fibrin was not as firm as that formed by the stronger current. The wire was blackened and slightly corroded. On another dog 10 ma. were passed for one hour with similar results. In the case of a wire left in the aorta for an hour with no galvanism the wire collected no fibrin.

In order to observe more carefully the effect of different currents upon the aortic wall, two dogs were prepared as above, and currents of respectively 100 ma. and 20 ma. were passed for an hour. Both wires collected about the same quantity of fibrin. The aortic wall subjected to the stronger current showed decided destruction of tissue wherever the wire came in contact with it, while that of the weaker current was merely discolored in similar situations.

We shall dwell but briefly upon the operation itself as the points are covered more thoroughly in our report of cases. In thoracic aneurism one of the greatest claims of this method over that of distal ligation is the fact that the patient does not require an anæsthetic.² This is particularly advantageous in cases of dyspnoea and bronchitis from pressure on the trachea. Locally cocaine or ethyl chlorid may be used. Usually the needle is inserted where the sac wall seems nearest the exterior surface. If there be more than one point of bulging and it be suspected that a multilocular or very large sac is being dealt with it would be advisable as suggested by Stewart to pass wires at more than one point and attach the positive pole to each. The needle should be inserted as nearly as possible with the direction of the entering current and away from the mouth of the sac. If a kink occur after some wire is in, one inserts another needle and after passing the required amount of wire both wires are attached to the positive pole.

For the abdominal cases make the usual preparations for celiotomy. Be particularly careful to clear the intestines in order to have the field of operation as free as possible. The method of exposure of the sac will have to be determined for

the different organs, the adhesions present, the direction in each case according to the position of the sac, its relations to which the needle should be passed and other contingencies that arise after opening the peritoneal cavity.

We present below a brief summary of all cases treated both by Moore's method of wire alone, and by the method of Corradi in which electrolysis was used.

ABSTRACT OF THE CASES TREATED BY THE WIRE (MOORE'S METHOD).

CASE I.—Moore: 1864. *Medico-Chirurgical Transactions* (Lond.) Vol. XLVII, p. 129.

Man; aged 27. Aneurism of the ascending aorta. Connected with this by openings in second and third interspaces, an extrathoracic aneurism of large size, increasing and threatening to burst.

Operation.—Twenty-six yards fine iron wire introduced through canula and pushed entirely in by blunt trocar; one hour; no pain; a slight and transient feeling of faintness; not over one half ounce of blood lost.

Effect.—Pulse reduced from 116 to 92, almost complete cessation of pulsation, and a diminution in size of tumor. Nine hours later patient asleep and pulse 78. On the next day the patient was seized with rigors and high fever, and died the fifth day with symptoms of sepsis.

Autopsy.—"Interior of tumor filled, for the most part, with a fibrinous coagulum, enveloping and embedded in the coils of wire, and firmly adherent to the surrounding walls."

CASE II.—Domville: 1871. *Lancet* (Lond.), Vol. III, p. 287.

Man; aged 40; a private in the Royal Marines, employed as a shoemaker. Two pulsating tumors of the size of half-oranges, projecting two and one-half inches from the chest, one on either side of sternum, about on level with nipple-line. Three months' treatment by iron, sedatives and iodid of potassium pushed to iodism. Tumor increased and "rupture became imminent."

Operation.—Fourteen inches fine iron wire passed through canula into tumor from left side, wire being passed until resistance was felt.

Effect.—At first seemed decidedly beneficial, the tumor becoming firmer and the impulse and discoloration less; but five days later the bulging again increased and the sac thinned so greatly in two weeks that oozing began from the site of puncture, and the patient died one month after operation from rupture and sudden profuse hæmorrhage from the sac.

Autopsy revealed a fusiform dilatation of the whole arch; and arising from this, at a point two inches above the valves, a large sacular dilatation. Springing from this large sac was a second but smaller sac which had eroded the sternum on the left and formed the visible pulsating tumor. The wire was found coiled in the form of a figure eight, lying imbedded in coagulum on the bottom of this outer sac.

CASE III.—Murray: 1872. *British Medical Journal*, 1872, Vol. I, p. 596.

Thoracic aneurism, first treated by needling, then by the insertion of catgut, and finally by Moore's method, 24 feet of wire being inserted. Patient died in three weeks.

CASE IV.—Rubio: 1874. *British Medical Journal*, 1886, Vol. I, p. 395.

Case of innominate aneurism; treated by 8 feet of iron wire; showed no change of symptoms during the first four days; was then lost sight of; presumed to have died.

CASE V.—Loreta: 1885. *Memoirs "Royal Academy" Bologna*, Vol. 6, Series IV; *Abstract British Medical Journal*, 1885, Vol. I, pp. 745 and 955.

² Reeve used Schleich's solution for his case, and Dr. Finney wired an abdominal case October 19, 1900, using the same anæsthesia.

Sailor; aged 30; syphilis 5 years before. Large abdominal aneurism filling epigastrium and left hypochondrium.

Laparotomy.—Six feet fine silvered copper wire through a fine trocar. Rapid, progressive recovering. Patient passed a good night after the operation, the first in two months. Pulsation diminished same night, and the femoral pulse, before almost suppressed, reappeared. Left hospital, well, ten weeks after operation with walnut-sized hard mass in place of the large pulsating sac.

Died thirteen weeks after operation from rupture of aorta at inferior angle of junction of sac with aorta.

CASE VI.—Cayley: 1886. *Medico-Chirurgical Transactions* (London), Vol. LXIX, p. 267.

Sailor; aged 48. Rheumatic gout; alcoholic; syphilis 27 years before. A hen's-egg-sized, oval, elastic, pulsating tumor rising three inches into neck above right sterno-clavicular articulation. Tracheal pressure symptoms. Rigid Tufnell's diet, rest, iodid of potassium. Aneurism threatening to burst; Mr. Hulke passed 30 feet fine steel wire, resulting in complete consolidation of external portion. Exterior of tumor backward and to left, threatening death by pressure on trachea. Six weeks later Mr. Hulke passed 35 feet of wire into tumor which had appeared in the left sternoclavicular region. No improvement; death nine days later from dyspnoea, due to tracheal pressure.

Autopsy revealed very large aneurism arising by large opening from a dilated ascending arch. The wires from both operations were imbedded in firm pinkish clot and separated from the main blood stream and the red post-mortem clot by a layer of thin decolorized fibrin. The opening from the aorta into the aneurism was so large that the lower portion of the sac still received a strong blood current and made the fatal pressure on trachea.

CASE VII. Lange: 1886. *Medical News* (Phila.), Vol. XLIX, p. 582. See also *New York Medical News*, Nov. 21, 1886.

An abdominal aneurism upon which Lange proposed imitating Crèvecoeur's procedure; but, there being evidence of rupture of the aneurism, Lange passed 9 feet of thin wire without laparotomy. This probably caused a shunting of more blood through the feeding portion of the sac, for in a few days a large pulsating area appeared in the right lumbar region. Twenty-four feet of wire were passed into the pulsating area. Death twelve days after operation, from pneumonia.

Autopsy.—A double fist-sized aneurism, situated just below diaphragm, communicating with the aorta through a lengthy opening on the posterior side of this vessel. The walls of the sac were quite firm from organized fibrin. The sac was ruptured on the right side. The original sac contained an immense quantity of blood about the wire. The wire introduced into the second pulsating area, or that in the lumbar region, was quite free from clot.

CASE VIII.—Ransohoff: 1886. *Medical News* (Phila.), Vol. XLIX, p. 597.

Colored man; aged 35. Moderate drinker. Admits having had chancre, but denies syphilis. A fist-sized, pulsating conical tumor, occupying second and third right interspaces. Slight exertion often followed by severe paroxysms of dyspnoea that often terminated in death. Dyspnoea and oedema of right upper region make anæsthetic and distal deligation impracticable.

Operation.—Eight feet flexible silver wire passed through intercostal space; syncope after 4 feet had passed. Great amelioration of symptoms; two weeks later patient became worse; sternal pulsation of tumor increased in size; 8 feet of wire into this portion; patient died one month after first operation.

Autopsy.—Aneurism of ascending portion of arch, anterior sur-

face; dimensions, 7 x 4 inches; mouth of sac an inch in diameter. Aneurism ruptured on posterior lateral wall into right pleural cavity. Wire covered by recent coagulum. One loop had passed through the aortic opening and rested just above, and in close relation to one of the leaflets of the aortic valves. Hence the syncope during the first operation.

CASE IX.—Morse: 1887. *Pacific Medical and Surgical Journal*, Feb., 1887; *Abstract in Medical News*, Phila., March, 1887.

American; aged 32. No history of syphilis or alcoholism. History of traumatism. Improved on rest, diet and iodid of potassium. Returned to work after three weeks' treatment. After three months, returned with "all signs of an abdominal aneurism."

Operation.—Laparotomy; aneurism double first size; five and one-half feet, one-half millimeter, silver-plated, copper wire passed through a needle one millimeter in diameter. After operation patient suffered several days from vomiting, but temperature never rose above 101°. Rapid recovery, patient leaving hospital eight weeks after operation feeling perfectly well. Tumor, on dismissal of patient, consisted of a hard nodule, one-half the size of original tumor, with only communicated pulsation and no bruit.

The wife of the late Dr. Morse writes that this patient lived in good health four years, doing the heaviest kind of work as stevedore. Then, after a prolonged debauch and a kick in the abdomen by a companion, he had a spell of uncontrollable vomiting, during which he died from hæmorrhage.

CASE X.—Pringle and Morris: 1887. *Medico-Chirurgical Transactions*, London, LXX, 261.

German tailor; aged 46; history syphilis. A visible, pulsating, expansile tumor of the abdomen. Signs of erosion of the vertebrae.

Treatment.—Rest in bed, Tufnell's diet, potassium iodid, morphia. Aneurism increased and "patient's strength at a low ebb."

Operation.—Laparotomy; exposure of sac; trocar and cannula introduced downward and to the left; after one foot of steel wire had been passed a kink occurred, and wire was cut off and end pushed in. Patient died fifth day from asthenia; highest temperature had been 100.6°.

Autopsy.—Localized recent peritonitis in operative region. Aneurism arises from posterior part of aorta and to the left, opposite the origin of the celiac axis and sup. mes. ar. Opening oval, measuring one inch vertically by five-eighths of an inch transversely. Ante-mortem clot found throughout the sac, being greater on the left side, where, by means of the galvanometer and poles of a battery, the wire was located. The wire had obviously fallen from its point of introduction and lay embedded in this portion of the sac.

CASE XI.—White and Gould: 1887. *Medico-Chirurgical Transactions*, London, LXX, p. 277.

A smith; aged 48; denies syphilis. Swelling of right chest noticed for five months; for two months a severe cough; dark thick expectoration; pain in the swelling.

Treatment for six weeks by rest, restricted diet and iodid of potassium, with no results. Swelling rapidly increasing in size and threatening death by rupture.

Operation.—Cocaine; Southey's trocar into third intercostal space at spot where pulsation seemed most superficial. After passing 9 or 10 feet of fine steel wire it broke, and a second cannula was introduced and 22 feet were introduced through it. Patient became faint but did not complain of pain. Death, ninth day, after more or less constant oozing of blood-stained serum through the site of operation.

Autopsy.—Fusiform aneurism of ascending arch, and from this, communicating by a large opening, arose a cocoanut-sized saccu-

lar aneurism. From this arose an extrathoracic portion with no definite sac wall, but being limited by a soft, shreddy, muscular tissue, abundantly infiltrated with blood and serum.

The external portion and the saccular aneurism contained a confused mass of steel wire, in the meshes of which, and surrounding which, was a considerable quantity of firm red fibrinous clot.

The mouth of the sacculated portion entering the aorta was very large, admitting four fingers; through this had extended a loop of wire into the fusiform dilatation of the arch.

This was an unfavorable case because of its rupture before operation and advance into the softer extrathoracic tissues. The fatal termination was due to the sloughing of the tissues over the aneurism, hastened by a pad over the oozing tissues pressing through on the unyielding mass of wire beneath.

CASE XII.—Hulke: 1887. *Medico-Chirurgical Transactions*, London, LXX, p. 289.

Seamau; aged 31; heavy work; denies syphilis.

Diagnosis.—Aneurism of innominate and aorta.

Treatment.—Severe Tufnell plan.

Improved and left hospital.

Returned about five months later in a desperate condition.

Operation same day: Ether; 10 to 11 yards pianoforte wire introduced through a small canula. Felt better several days; aneurism decidedly firmer; on fifth day oozing began just above site of puncture from a crack in cuticle; aneurism began to enlarge; on twelfth day oozing from side of aneurism at a distance from site of puncture. Difficulty of breathing increased; died after 13 days, apparently from exhaustion.

Autopsy.—Aneurism of first part of subclavian. The wire, covered with a considerable layer of white fibrin, filled all parts of the sac except the upper. It was this portion which continued to expand, and from which the oozing took place.

CASE XIII.—Stevenson: 1895. *Lancet*, London, Vol. I, p. 22.

Gunner in English army; aged 25; denies syphilis. A tumor with all characteristics of an aneurism, two inches below the costal margin and three inches to left of median line; size of a large orange; movable as patient moved from side to side.

Treatment.—Tufnell's diet, iodid of potassium, absolute rest in bed; also at suggestion of Professor Wright, calcium chlorid and inhalation of carbon dioxid gas. Coagulability of blood considerably increased, but no change apparent in tumor after three months.

Operation.—Laparotomy; transverse colon and omentum pushed up; many adhesions being broken. Two yards of finest steel wire introduced, the last end being pushed through canula by blunt knitting-needle. No bleeding on withdrawal of canula; but that evening there was a severe hæmorrhage from lower end of wound, corresponding to the site of trocar puncture through the sac. This hæmorrhage reduced the condition of patient and he died 27 hours after operation and 11 hours after bleeding had ceased, probably from syncope on attempting to sit up in bed.

Autopsy showed sac to arise from proximal end of superior mesenteric artery and to involve the anterior wall of the aorta. "Sac completely filled by coagulum and silver wire."

CASE XIV.—Langtou: 1899. *Brit. Med. Jour.*, Vol. I, p. 791.

A woman gave birth to a child three months before admission to the hospital. Since labor she had noticed an abdominal swelling; and, on admission, there was a pulsating tumor in the epigastrium, three and one-half inches in diameter, movable laterally, but not vertically, and over it was a loud systolic murmur. In April, 1898, the swelling being on the increase and the pain intense, an exploratory laparotomy was performed, and the tumor found to be an aneurism of the upper part of the abdominal aorta. A trocar and cannula were introduced and an

attempt was made to pass salmon-gut into the sac. This proving difficult, 5 feet of silver wire were passed with ease.

Careful examination a month later gave evidence of consolidation. At the time of the report, March, 1899, there was "a hard mass in the middle line much smaller than before the operation, and the thrill and bruit had disappeared. Her health was excellent."

ABSTRACT OF THE CASES TREATED BY PASSING ELECTRICITY THROUGH A PERMANENT WIRE. MOORE-CORRADI METHOD.

CASE I.—Burrelli (Corradi): *Lo Sperimentale*, April, 1879, p. 445. See later account by Marcacci: *Giornale Internazionale delle Scienze Mediche*, 1881, p. 1109.

Man; aged 43. Large aneurism of ascending portion of arch of aorta. Considered a hopeless case because of thin wall and rapid expansion. Medical treatment of no avail. Corradi inserted a canulated needle into second intercostal space, directing the point away from the probable site of opening from the aorta. Forty-two cm. (17 inches) of No. 30 annealed wire were passed, the needle being constantly circumducted with the object of giving the wire a coil as it entered the lumen. The needle being withdrawn, the end of the wire was connected with the anode of a galvanic battery of 16 elements, tested by a voltammeter to yield 1 cc. of hydrogen gas for the first minute. Cathode to chest-wall. Current passed for 25 minutes. At the end of the first 15 minutes of its application all pulsation had disappeared except that communicated.

Operation well borne. Pain entirely gone at end of third day. Patient continued to do well for a time, but subsequently all symptoms returned and he died 3¼ months after operation. No autopsy.

CASE II.—Barwell: 1886. *British Medical Journal*, Vol. 2, page 675.

Man; aged 39; syphilis 20 years before, secondary symptoms for eight years; thoracic aneurism; a visible pulsating tumor from first to third costal cartilage on left side.

Treatment.—Rest and diet for seven months; at first improved, only to become worse.

Operation.—About ten feet of the finest steel wire through a hollow needle of ivory; this wire connected with the positive pole of a battery, the negative being applied by means of a large pad of spongio-piline to the back. A current equal to nine or ten milliamperes passed for one hour and ten minutes, the man feeling no pain or inconvenience. No change in tumor during operation, but at end of twelve hours patient appeared very much improved, the tumor more solid, the pulsation more distant.

Four days after operation a tumor appeared to right side of sternum, which the patient said had existed there two years previously. The man died a week after the operation from rupture of the new right sac into the right pleura.

Autopsy.—"The wide coils of wire are surrounded by thick firm, colorless clot, which in many places binds the wire to the sac-walls, thus strengthening them and rendering rupture hardly possible wherever the wire had penetrated. This had not occurred in the secondary sac."

CASE III.—Roosevelt: 1887. *Medical News*, Vol. L, 398.

Man; aged 25. Syphilitic history. Thoracic aneurism on the right, involving the four upper ribs near the sternum. Rest and potassium iodid two weeks; tumor increased, and case became utterly hopeless.

Operation.—No anæsthetic; a short insulated aspirator needle into tumor; 225 feet fine (No. 00) steel piano-wire passed in about 25 milliamperes passed for one-half hour without pain.

Next day tumor pulsated less strongly. "By the tenth day

tumor was much less painful, the pulsation visibly diminished, and he could breathe easily lying on his back or left side, which he formerly could not do." During third week he could swallow and breathe with greater ease, and the tumor felt harder. On the 21st day he began to vomit and complain of headache. On 22d day a painful dark-colored spot appeared on one toe and the man appeared bad. Death on 23d day; no autopsy.

CASE IV.—Abbe: 1887. Medical News, Vol. L, p. 397.

Man; aged 46. Thoracic aneurism filling right supraclavicular space.

Operation.—One hundred feet No. 1 catgut passed into sac; outer one-third of sac became harder but the remainder continued to increase. Nine days later, 150 feet of fine steel wire passed through an insulated aspirator needle; a large copper plate, covered with wet cotton, placed at back.

Current of 50 milliamperes passed one-half hour; then 100 milliamperes for same time. Then, with the negative pole connected with the wire and the positive with the plate, a current of 100 ma. was passed in the reverse direction. Patient rather exhilarated than otherwise. Tumor still pulsating at conclusion. Death 2d day from rupture of sac into trachea. No autopsy.

CASE V.—Kerr: 1889. Occidental Medical Times, January.

A Greek; aged 38; syphilis.

Diagnosis.—Aneurism of ascending arch.

Treatment.—Rest in bed, on low diet and potassium iodid for three months; no improvement.

Operation.—Six feet drawn silver wire introduced through a medium-sized hypodermic needle covered with shellac; positive pole connected with wire, negative pole with tin plate over epistrium; current, strength not stated, passed for 50 minutes. Relief from pain and diminution of pulsation, but on ninth day patient complained of a pressure behind sternum; on twelfth day pulsation well marked in suprasternal notch, and on eighteenth day patient died.

Autopsy.—Fusiform aneurism extending from base of heart to origin of left subclavian. "The wire entered the anterior surface of the sac; and around it, as well as on the walls, a firm clot was formed."

CASE VI.—Kerr: 1889. Occidental Medical Times, January.

Man; aged 56. Duration, 10 months; had been unable to work for 3 months past. On admission a pulsating tumor found on right side of sternum, extending to right mammary line and from second to fourth intercostal space.

Treatment.—Rest and potassium iodid two months—no improvement; electrolysis through two needles—no improvement.

Operation.—Ten feet drawn silver wire inserted, using the same method as with his first case. During the half-hour of electrolysis the pulse was very small and rapid, and there was distress and dyspnoea, but no pain. For a month he had slight burning and pain over the aneurism; these disappeared and the pulsation diminished in area and force. At the end of two months the patient left the hospital, saying he "felt as well as ever."

Dr. Kerr writes me that he knew the patient to be working as a street-paver for 10 months after discharge, and then lost trace of him, although the patient promised to send for him or enter hospital should he again be troubled.

CASE VII.—Rosenstirn: 1891. American Journal of the Medical Sciences, N. S., Vol. CI, p. 55.

Member of the victorious Harvard crew of '83; aged 25; weight 160. "He loved wine, women and song—the two former most." Consulted Dr. Rosenstirn first in 1888 with palpitation of heart and slight dyspnoea. Later a distinct pulsating tumor found occupying second and third intercostal spaces in the right paraxial line. Absolute rest in bed, low liquid diet, cautious massage of extremities, large doses of potassium iodid. Three

months gave no apparent benefit. In January, 1889, electrolysis through two needles on two different occasions; effect nil; symptoms grew worse; desperate condition.

Operation.—Twenty-six inches of spirally wound, moderately thick, softened silver wire passed through an explorative trocar and the end pushed entirely in. Then a current of 70 milliamperes passed through the trocar for thirty minutes. Patient bore operation remarkably well. After a few days pain began to subside, and after two weeks the breathing became easy and he had no more attacks of suffocation. In two months the pulsation entirely disappeared and patient was finally in most excellent health.

A letter from Dr. Rosenstirn says his patient now weighs about 280 lbs., is in good health, and leading an active life as captain or colonel of one of the volunteer regiments stationed on the Pacific coast.

CASE VIII.—Stewart: 1892. American Journal Medical Sciences, Vol. CIV, p. 422.

Insurance agent; aged 30; fond of wrestling. First examined in July, 1888; a small, expansile, pulsating swelling to the left of the upper lumbar vertebrae. Improved under three months' treatment by rest and potassium iodid, and went to work. In September, 1891, had been in bed two months with pain and prostration. Now a very large lumbar aneurism, having three large bosses, which in places seemed very thin. Signs of spinal-cord involvement.

Operation.—Two and one-half feet rather heavy silver wire (No. 23, Brown & Sharp gauge), coiled for spiral arrangement, passed through an insulated (shellac) steel needle. Current gradually increased until 70 milliamperes were reached and this strength maintained for one hour. The negative electrode was a very large felt-covered plate, which lay upon the right shoulder and scapula. Patient showed evident improvement for a few days, but pain grew worse, and on the ninth day, after thumping the aneurism with his fist, he had a gush of blood from mouth and died.

Autopsy.—An aneurism of immense size, filling hypochondrium and a part of the lumbar region. It had evidently arisen from the posterior and left lateral wall of the thoracic aorta and subsequently involved a portion of the abdominal aorta. The site of rupture was in the upper left portion, where the sac wall and laminated clot had been penetrated. A large sinus plowed into the lung. The highest coil of wire was two and one-half inches distant from the point of rupture. Firm clots in all portions of aneurism with soft clots of recent origin. The wire engaged in several large firm clots of so solid a texture that they were separated from the sac and wire only with some difficulty. The rupture was probably due to failure of wire to reach all parts of the large sac and consequent increase of pressure on a portion that had not yet been strengthened by fibrin formation. Stewart regrets not having used more wire.

CASE IX.—Stewart: 1896. American Journal of the Medical Sciences, Vol. CXII, p. 170. Autopsy; British Medical Journal, August, 1897, p. 387.

Man; aged 40; vagrant habits; syphilis in 1881; evidences of aortic and mitral disease; much albumin in urine. Large aneurism right chest; put on Tufnell's treatment and potassium iodid; aneurism increased in size, became very thin-walled; rupture seemed imminent. Refused interference by deligation.

Operation.—Conjoint use of the wire method and of galvanopuncture by means of several platinum needles connected with the same rheophore as the wire, hoping thus better to secure an extensive coagulum from wire to needles and to sac wall. Two platinum needles good caliber, insulated to within an inch of the end, first introduced toward periphery of sac. Ten feet of fine gold wire, drawn hard to No. 30 gauge, played into sac;

positive pole connected with wire; negative pole, a large clay plate, placed upon the abdomen; current gradually increased to 80 milliamperes and there kept for one hour.

Before end of session much less marked pulsation in sac; needles moved about with difficulty; procedure well borne; no pain felt at any time during operation or subsequently, and no evidence of shock.

Four weeks later, it being considered that only the lower part of the sac was filled by clot, another attempt was made to enter wire into upper portion of the sac, and this was found to be filled by coagulum.

Patient lived nearly three and one-half years after operation and "died as the result of the formation of a large thrombus in the middle cerebral artery, the result of the advanced endarteritis present."

Autopsy.—The aneurismal sac springs directly from the root of the innominate artery; approximately the size of a fetal head at term; completely consolidated with organized coagula, in which lie the coils of wire.

CASE X.—Hershey: 1896. The Therapeutic Gazette, Vol. XX, p. 590.

Man; large aneurism right chest, probably sacculated innominate aneurism.

Treatment.—Rest in bed, diet, barium chlorid. At end of 7 weeks symptoms all exaggerated.

Operation.—Two and one-half feet gold wire, hard drawn to No. 28 gauge, passed through hypodermic needle insulated with gum shellac. Usual method of galvanism with indicator kept at 70 milliamperes for an hour. "The needle, at first moving freely with each heart beat, became fixed; and instead of the soft, full, pulsating mass characteristic of an aneurism, was felt a hard resisting tumor much smaller."

Patient slept on back that night for the first time in 7 weeks. After 2 months, returned to work, and 9½ months later, at time of report, the patient was well and at work as a mining prospector.

Dr. Hershey writes me that one year after operation the symptoms began again, and the patient died 14 months after operation from rupture of the sac. No autopsy.

CASE XI.—Stewart: 1898. Phila. Med. Jour, Nov. 12.

Day laborer; aged 40; entered Episcopal Hospital because of a pulsating tumor in the upper left quadrant of the abdomen. Patient had had syphilis; possessed sclerosed arteries; urine indicative of Bright's disease.

Diagnosis lay between aneurism of the splenic artery and a pulsating abdominal tumor. Section disclosed what appeared to be a sacciform aneurism springing from the left of the aorta at the situation of the celiac axis."

Ten feet of fine silver wire were inserted and a current of 50 ma. passed by the anode for a half-hour.

Patient died suddenly the fifth day. Examination of abdominal contents through the wound revealed a large retroperitoneal tumor almost encircling the aorta, causing a marked fusiform dilatation extending even above the diaphragm. Continuous with this fusiform widening there was a small sacciform aneurism of what appeared to be the splenic artery.

The wire had been passed through a portion of the tumor into the sacciform aneurism and thence into the dilated aorta. No clot was found on the wire within the aorta, and no mention is made of any wire stopping in the saccular aneurism.

Death was caused by hæmorrhage into the stomach, but its origin could not be determined.

CASE XII.—Stewart: 1898. Phila. Med. Jour., Nov. 12.

A railroad engineer; aged 42 years; history of syphilis; an extremely large thoracic aneurism of the transverse and de-

scending portion of the arch. Bad aortic and mitral disease. Constant intense pain, requiring the use of large doses of morphia.

Operation.—Fourteen feet of spirally wound fine gold wire were introduced at the more prominent part of the aneurism through two insulated needles. The terminal ends of the wire from these were connected with the anode and the current rather rapidly raised to 80 ma.; the electrolysis occupying 1 hour and 20 minutes. After the operation "the aneurismal swelling was decidedly less prominent, much less to-and-fro pulsation; bruit over mass not so apparent, and much less pain complained of." For periods the pain disappeared altogether. Three months after operation explorations were made with a large 3-inch needle in four different situations where the tumor seemed softest. The needle was inserted to its hilt and in but one place was blood reached. An attempt to insert wire here was baffled by the clot beyond, as but 2 or 3 inches could be passed.

The patient died suddenly eight and one-half months after operation. No autopsy.

"The aneurism in this case was much too large and the cardiac condition much too unfavorable" for one to expect a cure to result. "That the patient's life was undoubtedly prolonged and his condition made much more comfortable was unquestionable." Dr. Stewart regrets not having used 20 instead of 14 feet at the first operation.

CASE XIII.—Noble: 1898. The Philadelphia Medical Journal, Vol. 1, p. 1203.

An Englishman; aged 37 years; alcoholic; history of syphilis.

Examination.—A pulsating tumor, the size of a large fetal head, midway between the ensiform cartilage and the umbilicus. Great pain, requiring much morphia.

Rest in bed, as nourishing diet as could be taken with his difficulty in retaining food, potassium iodid, opium. Condition grew rapidly worse and at the end of two weeks operation was decided upon.

Operation (July 14, 1897).—Laparotomy; 8½ feet of hard-drawn, No. 30 gold wire passed through a needle insulated with celluloid, and tipped with gold.

Current slowly increased until 70 milliamperes was reached, and here maintained for 6 minutes. In all, about 35 minutes of electrolysis. Patient showed marked signs of failure and had to be hastened off the table. No pain after the second day and improvement was rapid. Pulsation about stomach disappeared and patient was able to retain nourishment. Discharged in 6 weeks, with the mass lessened to the size of an orange. Transmitted pulsation and a slight thrill could be felt. Patient died 8 months later with acute dysentery, intercurrent with great debility, due to a tumor of lower jaw. He had had no further symptoms of aneurism. No autopsy.

CASE XIV.—Halsted's case. See report below (Case I).

CASE XV.—H. A. Hare: Therapeutic Gazette, May, 1898.

Man; aged 46 years; history of syphilis; on admission, suffering from pain, dyspnoea and cardiac disturbances; later he developed brassy cough, and sputum became tinged with bright-red blood.

From the signs and symptoms a diagnosis was made of aneurism of the terminal portion of the transverse and the beginning of the descending aorta.

Patient did not improve under treatment by rest, potassium iodid and aconite.

Operation (March 3, 1898).—Nine feet spirally wound fine gold wire introduced through an insulated needle, and a positive current passed for 1 hour, increasing rapidly from a few to 70 ma.

The operation well borne. Signs of consolidation somewhat apparent towards the end of the electrical session, in that there was less excursion of the mass and of the needle; and the needle

acquired the sensation of engaging a more solid mass. The aneurismal bruit, very marked in the second left intercostal space before operation, had much diminished the day following the operation, and in 48 hours had entirely disappeared. The expansile pulsation and the thrill had greatly lessened.

Five weeks later: "The expansile pulsation and the thrill have entirely disappeared and the impulse in the second left intercostal space feels as the apex beat would feel if displaced. The bruit has entirely disappeared and only a double aortic murmur is to be heard. Blood-spitting has not occurred. Cough has ceased."

The patient was in comparatively good health for 6 months after the operation, when symptoms began indicating the extension of the aneurism posteriorly and to the left. He died in October, 7 months after operation, from symptoms of pressure on the trachea. No autopsy.

CASE XVI.—Finney's first case. See report below (Case II).

CASE XVII.—Reeve: 1899. *Annals of Surgery*, Phila., Vol. XXX, p. 704.

A negro, aged 49 years, who had been ill for 2 years, was admitted to the hospital complaining of abdominal pain and presenting a large dome-shaped swelling in the upper umbilical region. This tumor had been discovered 9 months previously, and two months before admission it was diagnosed as an aortic aneurism. Pain was intense, the patient being kept continuously under the influence of morphine.

Under Schleich's anæsthesia, celiotomy was performed and 7 feet of silver plated, soft, copper wire, .016 inch in diameter, were introduced before a hindrance occurred. The wire had no previous preparation to insure its coiling in the sac. The positive galvanic pole was attached and the current gradually increased to 80 ma., where it was kept for 50 minutes. Not much suffering caused by the current except at one time, when for a few moments it was increased to 110 ma. "After 50 minutes, syncope was threatened, and the séance was discontinued. Distinct firmness of the tumor had occurred, as well as a disappearance of the expansile pulsation."

The patient lived 24 hours.

An extract from the pathologist's report says: "An aneurism of the abdominal aorta, two inches above its bifurcation. A wire, irregularly twisted, occupied the center of the sac, surrounded by and mixed with old and recent clot; one end, together with a double loop of wire, passed up the aorta, the looped part reaching about ten inches, and the single strand quite up to the aortic valves of the heart, where it left a spot of ecchymosis. The aneurism was distinctly sacculated; the opening from the aorta into the sac being not over one inch in diameter."

CASE XVIII.—Corson: 1899. *The Phila. Med. Jour.*, Vol. III, p. 511.

Man; aged 31 years; excessive user of alcoholics; no definite history of syphilis. The patient complained of a hoarse cough and a severe pain under the left shoulder blade. His pulse was 10, and he was nervous and excited. Examination revealed a large pulsating tumor on the left side above the clavicle.

The trocar and cannula were inserted through the sternoleidomastoid muscle, and a drawn silver wire, six feet in length, was introduced. Eight cells of a dry-cell battery were used for two hours, the strength of current being regulated according to the patient's comfort. After a half-hour the pulsation began to grow less, and at the end of two hours the hardness of the tumor had much increased. Patient did well until the morning of the second day, when the cough and dyspnoea grew worse and patient died.

Autopsy revealed, as near as one can judge from the description, an aneurismal dilatation of the arch just above the heart, and from this an immense saccular dilatation, probably in the

course of one of the large vessels on the left. In this latter sac was "the wire coiled closely in contact with its walls." We infer that pure silver wire was used, and nothing is said of the thoroughness with which it was drawn. Pure silver, only slightly drawn, and with no precautions to insure its coiling, would be almost certain to take the faulty position described.

CASE XIX.—Stewart's fifth case—not yet reported.

A traveling salesman of Baltimore, with a large thoracic aneurism had refused operation for some weeks, until his condition became very desperate. His life being threatened from dyspnoea, he went to Dr. D. D. Stewart, of Philadelphia, who wired his aneurism on three different occasions with very good result each time. But, unfortunately, the relief was temporary and the aneurism continued to extend until the patient's death from rupture about nine months, I believe, after the first operation.

CASE XX. Hare: 1900. *Therapeutic Gazette*, Phila., Jan. 15, p. 9.

A merchant, aged 48 years, with no history of syphilis. A rapidly growing aneurism eroding the second, third and fourth ribs and the costal cartilages to the left of the sternum. First noticed one year previously. For 7 months the patient had been in bed and had lost 60 pounds in weight. The most prominent part of the growth was elevated about two and a half inches above the surface of the chest, but there were three spots in which the blood was evidently near the surface, and in which expansile pulsation was marked."

Operation (April 18, 1899).—The needle inserted into the apex of the growth and ten feet of gold wire introduced, and a current passed for one hour and thirty minutes, beginning at 10 ma. and gradually increased to 100 ma.

Marked improvement in the patient's condition, allowing him to sit up a portion of each day and to walk a little. The aneurism shrank and lost its expansile character except at one point. Because of this point of pulsation, Dr. Hare operated one month later in a similar manner, but this time he passed a second ten feet and kept the patient under the electrolysis for a second hour.

The aneurism persisted, and after two or three months gave evidence of extension to the left. Dr. Hare contemplated a third operation, when the patient died from rupture of the sac, on November 30. No autopsy. Dr. Hare says: "I have no doubt that his life was much prolonged in view of the thin sac wall at three points when he was first seen, all of which were threatening rupture at any moment."

CASE XXI.—Finney's second case. See report below (Case III).

CASE XXII.—Finney's third case. See report below (Case IV).

CASE XXIII.—Finney's fourth case. See report below (Case V).

Five cases have been operated upon at the Johns Hopkins Hospital, a report of which shows an interesting development of technique. The records of the first two cases, which were fatal, and upon which autopsy was held, and of the last case, are particularly valuable in showing the extreme difficulty in diagnosis of the actual condition, even with celiotomy. Appreciation of these difficulties will aid in making the prognosis sufficiently grave when laying the question of operation before the patient and his friends.

CASE I (Case XIV of entire series).—W. T. G., a printer, aged 27 years, was admitted, October 26, 1897, to the service of Dr. Osler. Dr. Norton, of Washington, sent the patient with the diagnosis of abdominal aneurism.

History.—Since a boy he has always been accustomed to holding type in his mouth. He has carried heavy "forms" of type resting against his abdomen, and has lifted heavy weights in the gymnasium. He has had several attacks of gonorrhœa, and about seven years ago an attack of acute arthritic rheumatism which he thinks was synchronous with nrethritis. No definite history of syphilis. He has been a pretty heavy drinker of alcoholics since a boy.

His present trouble dates since May or June of this year, when he began having a "dull dragged-out feeling" and occasionally sharp pains across the abdomen, which caused him to lie doubled across his printer's stool for the pressure benefit. At this time he often vomited after eating, but has not vomited for the past two months.

The pain and weakness have increased since May and he has lost about forty pounds in weight. During the past month he has been obliged to sleep on the left side or in the erect posture, because of pain when in any other position. Pain is referred to the pelvic region, at times shooting into scrotum, at times extending even to the knees. In walking the street a sudden jar gives great pain. He walks slightly bent forward to avoid pain. He first noticed pulsation in the abdomen one month ago.

On physical examination he is found to have moderately selected arteries; a markedly accentuated second aortic sound; no blue line on the gums or other evidence of plumbism.

On inspection of the abdomen a diffuse pulsation over the whole upper abdominal region, most marked in the left epigastrium, is seen. This region is prominent, and the left costal margin over the sixth and seventh cartilages is bulged slightly forwards. The pulsation is felt to be limited to the upper half of the abdominal aorta, over which a globular expansile mass the size of a very large orange can be outlined. A purring systolic and diastolic thrill is felt over the mass. Percussion gives dullness everywhere over the mass, but later, during observation, stomach tympany is found on percussion over its lower quadrant. On auscultation a loud double murmur—a systolic, loud, harsh, and short—a diastolic, fainter, prolonged, and almost musical in character—is heard. In the back a soft blowing systolic murmur is heard over an area to the right of the vertebræ extending from the eleventh dorsal to the first lumbar. The knee-kick is somewhat exaggerated.

The patient was irritable and incapable of restraint. He was kept on a moderately low diet and as quiet as possible on anodynes; but it was evident from the first that the aneurism was increasing in size and would, in all probability, soon prove fatal.

After having the possibilities of the operation presented, he begged that the attempt at cure might be made. He was transferred to the service of Dr. Halsted and, on November 24, operated upon.

A median incision was made from ensiform to umbilicus, exposing a pulsating mass in the epigastrium, seemingly about fist-size, lying behind the lesser peritoneal cavity. This could be reached only through the lesser omentum by pulling down the stomach and approaching the sac above the lesser curvature. An area 1 x 2 cm. was laid bare over the sac wall by blunt dissection through the posterior layer of the lesser peritoneal cavity and its underlying subserous fatty layer. The wall of the sac seemed very thin at this point. A distinct expansile pulsation and a thrill were perceptible to the fingers. A hypodermic needle was inserted to test the thickness of wall. A long aspirator needle of small caliber was inserted and an attempt made to pass a No. 27 wire (No. 5 piano-gage). This was of pure silver and undrawn, and had been rolled on a wood reel and boiled. After passing a few inches the wire kinked and both needle and wire were withdrawn. Bleeding followed but was easily controlled by pressure of a finger.

The needle was oiled and again inserted, and about 17 inches of No. 27 wire introduced, when it again kinked. The current

was passed through this for 12 minutes. The needle was withdrawn and the wire, being cut off near the sac, was pushed under the surface by catching it in the point of an aspirator needle.

A third and larger aspirator needle was now inserted and 38 inches of No. 25 wire (No. 4 piano) were passed through it with ease. Considerable bleeding took place from the lumen of the large needle, so it was withdrawn and the wire cut about a foot from the sac. Hemorrhage was controlled by slight pressure of a finger beside the wire at its site of entry.

The galvanic current was then passed, the anode being connected with the end of the wire, and the kathode with a large metal plate, wrapped with a towel and placed under the back. The electrolytic action was continued for 1 hour and 25 minutes, varying in strength from 30 to 100 milliamperes. At its height, the current caused contracture of the muscles of the trunk when there was any change made in its strength by the rheostat. No appreciable change took place in the pulsation of the aneurism during the process. The wire was cut off close to the sac and the posterior peritoneum closed over the site of puncture with fine silk sutures.

There seemed to be no other abnormality of the patient's abdominal viscera. His pulse varied between 90 and 120 during the operation.

He lived about 40 hours after operation and died with symptoms of sudden internal hemorrhage.

Autopsy Notes.—Abdominal wound, 16 cm. long, firmly glued together. A few delicate adhesions of omentum to abdominal wall beneath the incision. The aneurismal sac is collapsed; it lies behind the lesser peritoneal cavity to the left of the vertebral column, extending slightly beyond the right margin of same. It extends from the diaphragm to which it is firmly adherent to the renal vein, which runs transversely over its lower anterior edge.

It pushes the spleen to the left and touches the upper anterior surface of the left kidney. The pancreas lies over its lower third.

The left pleural cavity is found to contain an immense blood-clot, forming a complete mould of the cavity and weighing 1170 grams. In addition, 960 cc. of fluid blood are removed. The diaphragm is seen to bulge considerably into the pleural cavity, and at the summit of the dome is a ragged hemorrhagic area, the site of rupture. A little to one side of the perforation, which scarcely admits the tip of the little finger, lies a loop of the wire.

On opening the aneurism and the aorta the aneurismal opening is found to have a vertical diameter of 8.5 cm., while that of the sac is but 10 cm.

The aorta in this region presents a fusiform dilatation, its right border projecting slightly beyond the right margin of vertebral column. The anterior wall of this dilated portion of aorta is very rough and atheromatous, and peculiarly elastic. The posterior wall is thinned and so adherent to the vertebræ that these have to be chiseled away in order to remove the aorta and sac.

The aorta is considerably narrowed below the sac, its circumference above and below the aneurism being respectively 4.8 cm. and 3.4 cm. The chief abdominal vessels arise from the lower left portion of the sac; the celiac axis and superior mesenteric coming off within the sac, while the renals spring from the dilated aorta just at the mouth of the sac.

The wall of the aneurismal sac is everywhere thin; being thickest anteriorly and to the left, where the retroperitoneal tissues have assisted in strengthening it, and thinnest superiorly where it bulged toward the pleural cavity. Its inner surface is rough and covered with loose coagulum, there being no evidence of uniform lamellated deposit of fibrin.

The walls are held apart by 4 or 5 coils of silver wire, which

lie peripherally and near together, forming an ellipse whose plane is anterior-posterior with reference to the body. These coils are covered by loose coagulum, which readily becomes detached on manipulation.

Death, from rupture of the very large, tense and thin-walled sac, with enormous mouth, could not have been long delayed; but it is probable that it was hastened by the wire working against the sac wall.

Considering the position of origin of the celiac and superior mesenteric vessels from the wall of the sac, there can be no doubt that the patient's death would have been even more precipitous had there been a formation of an obliterating clot during the operation.

CASE II (Case XVI).—R. E., book-keeper, aged 25 years, admitted to the service of Dr. Osler, July 29, 1898, complaining of an abdominal tumor with pain.

Family history good.

Personal history.—Childhood's diseases, no scarlet or typhoid fever, no diphtheria or lung trouble. Malaria for several summers as a boy. No rheumatism. Urethritis at 19 for 2 or 3 months; no sequelæ. Bubo at 21, on both sides; knows of no cause, but at the same time had an herpetic eruption on penis. Had not been exposed in venery for 2 or 3 months before this. Alcoholics very moderately. No tobacco. No heavy work. No traumatism.

Present illness.—In October, 1897, the patient had a severe pain of a sharp, steady character just below the umbilicus. This lasted one week, keeping him awake at night. He had no more trouble until March, four months ago, when he noticed tenderness on the right side just below the costal margin and in the flank. In a few days such severe pain set in that opiates were resorted to. Gradually his skin became yellow and his urine very dark. The stools were never noticed to be clay-colored. The jaundice was of five weeks' duration. The pain has gradually increased since March, never being of a throbbing character.

Physician's examination in April was negative. On July 20, he was examined under anæsthesia and a diagnosis made of abdominal aneurism.

On admission, careful physical examination was negative, except for sclerosed arteries and the abdominal tumor.

In the epigastrium was seen a marked pulsation. On palpation a marked shock and distinct purring thrill were felt with each systole. One could outline a globular mass about as large as a medium-sized orange, and from this get expansile pulsation. On auscultation, a loud, amphoric, systolic murmur was heard, limited to the tumor area. No diastolic murmur. Second sound very faint. No murmur heard at the back.

Operation.—During one month of treatment on absolute rest, restricted diet, and iodid of potassium, the aneurism continued to enlarge and the pain to increase.

On August 27, Dr. Finney performed the Moore-Corradi operation. Under ether a median incision was made from ensiform to umbilicus, exposing the lower border of liver and upper border of stomach. Between these lay the sac almost completely hidden by a flattened-out pancreas.

The sac seemed globular, about 7 cm. in diameter, and apparently extended around the aorta, resting on the transverse processes of the vertebræ. The pancreas was separated with difficulty and finally had to be divided in order to expose the sac. Beneath its upper border and flattened out across the sac was the splenic vein, about 1 cm. in breadth. Puncture was made in the upper edge of the sac just above this vein, the needle pointing downward and as nearly parallel with the aorta as convenient. Five feet of silver wire were passed through this fine insulated aspirator needle. The wire was alloyed with 75/1000 of copper and drawn from No. 8 to No. 27. After being

smoothly wound on an ordinary spool, it was boiled for 15 minutes for sterilization and to give it a good spring following the swelling of the wooden spool. The wire was passed without particular difficulty by grasping it between the thumb and first finger and passing very short portions at a time. Slight oozing through the needle made the fingers very slippery, and they had to be repeatedly rubbed over an alcohol sponge.

The galvanic current was begun at 30 ma. and increased 10 ma. each 5 minutes until 70 ma. was reached, where the current was kept one hour.

After a half-hour the thrill, very marked at the beginning, had disappeared. The expansile pulsation had decreased but seemed to increase with each addition of fresh ether and resultant stimulation of the heart. At the end of this electrical session there was no thrill; no expansile pulsation could be determined; the sac was firm and decidedly smaller, as could be seen by the manner in which the splenic vein, before flattened, now stood out on the sac as a rounded vessel. After closing the abdomen nothing but a communicated pulsation, as of a solid tumor lying over the aorta, could be made out.

The success of the operation seemed assured; but, from his recovery from ether, the patient complained of excruciating pain, which increased until, within a few days, morphia was being given in $\frac{1}{4}$ -gr. doses every 2 to 4 hours.

His temperature on the day following operation reached 102.5°, and on the third day 103.7°. Careful examination of the wound revealed nothing, although we had feared infection of the tissues made necrotic about the needle from the electrical current, and over this area in the mutilated and much ligated pancreas.

We decided that this temperature must be due to the sloughing tissues over the back; for the metal plate, which had been wrapped with a towel repeatedly moistened, had caused an unlooked-for necrosis of the skin. But on the 7th day pus was found in the upper half of the wound, apparently involving only the subcutaneous and muscular layers of the abdominal wall. The temperature lowered somewhat but remained about 100° F. until the 14th day, when it again went up, reaching 102.8° F. on the 17th day.

For the first four days no expansile pulsation could be made out, but on the fifth day it was distinct, and the sac from this time seemed to increase in size. On the 16th day nausea began, and from this time the patient was in extreme discomfort. On the 19th day there was bleeding of about 300 cc. of bright-red blood from the upper end of the granulating wound. The patient became very weak and pale, and it was evident that he was having internal hæmorrhage. He died on the 20th day, 7 hours after the hæmorrhage through the external wound.

Autopsy (No. 1144).—The lower end of the abdominal wound healed per primam; the upper end separated and granulating. On opening the abdomen there was found a sinus, filled with blood-clot, leading from this granulating wound down to the sac at the site of puncture. Local peritonitis existed about the wound. The lungs were normal. The heart presented slight thickening along the free margins of the tricuspid and mitral valves. The aorta beyond the valves showed well-marked nodular, and in places diffuse arterio-sclerosis. The patches were a trifle raised and of yellowish-white color. This condition extended into the abdominal aorta.

In the upper portion of the abdomen, partially covered by the pyloric end of a distended stomach, the beginning of the duodenum, and the right lobe of the liver, was a firm globular tumor mass. Flattened out over this and almost completely covering its anterior aspect, was the pancreas. The splenic vein ran across the tumor near its upper border and was covered by the pancreas. Just above the vein was the sinus of blood-clot before mentioned.

At the upper border of the tumor the celiac axis could be dissected free with its three branches.

On opening the aorta by cutting along its posterior wall, an opening $1\frac{1}{2} \times 1\frac{3}{4}$ cm. in diameter could be seen on the anterior wall leading into the aneurism. This was evidently the greatly dilated orifice of the superior mesenteric artery, of which artery the aneurism was a dilatation. One centimeter above this opening was the orifice of the celiac axis. The inferior mesenteric arose $3\frac{3}{4}$ cm. below.

The renal arteries, one on either side, took origin on the lower margin of the opening.

Near each renal orifice, immediately on the margin of the aneurismal orifice, was a blackened slit-like sulcus in the arterial coatings. Although there was no wire in the mouth of the aneurism at time of autopsy, it appeared as though one loop had swung across the mouth with its convex side in the aorta, thus burning the margin as described. (From this, as well as from experiments upon free blood and upon dogs, we conclude that a current of 70 ma. is dangerous.)

Looking into the aneurism through its comparatively small orifice, one could see numerous segments of coiled wire immediately about the mouth of the sac, the greater portion of each coil being embedded in a solid ante-mortem clot, which apparently almost filled the sac. Further examination was postponed until the specimen could be hardened.

The marked dilatation of the stomach was apparently due to pressure on its pyloric end as it crossed the sac. The bile-ducts were incorporated in the misplaced tissues to the right of the sac, and this suggests pressure as the cause of jaundice in the early history of the patient's suffering. The duodenum was adherent to the sac throughout its whole length. The duodenum, the jejunum, and the upper portion of the ileum were of a dark chocolate color, and on being opened were found to contain considerable bloody fluid. Their mucosa was of the same chocolate color, but seemed otherwise normal, except at one portion of the adherent duodenum.

At about the transverse portion of the duodenum there was an irregular area measuring about $4\frac{1}{2} \times 6\frac{1}{2}$ cm., over which the mucosa was exceedingly hæmorrhagic and partially necrotic. Just in this locality were found, in addition to the bloody fluid, several large fresh clots. No definite opening into the aneurism could be found, and our conclusion was that very rapid oozing had taken place through the greatly thinned walls of the adherent sac and bowel.

The large intestine was normal in appearance.

The pancreas over the tumor showed no trace of having been cut in two. There were a few small white areas of necrosis over its surface.

The spleen was considerably enlarged but otherwise normal in appearance. The liver was rather pale, and on section has a fatty appearance. The kidneys showed macroscopical evidences of parenchymatous degeneration.

The Aneurism.—On cutting through the aneurism dorsoventrally (see photograph) one gets the impression that we are dealing with a *false* aneurism. Immediately about the aortic opening is the remainder of the dilated lumen, which, in the contracted condition of the sac, is a cavity about 4 cm. in diameter.

The wall of the aneurism may, for convenience of description, be divided into two portions—the ante-operative and the post-operative. Each of these averages about 2 cm. in thickness.

The ante-operative portion consists macroscopically of two layers: an outer, light-colored, fibrinous-looking layer (see cut) (a), averaging $\frac{1}{2}$ cm. in thickness, which merges into the inner layer (b), $1\frac{1}{2}$ cm. thick, and dark-red, appearing like an old firm clot.

Near the aorta the greatly hypertrophic superior mesenteric wall can be traced for a short distance until it is lost in the looser and thicker portion described above. The wall is rein-

forced near the aorta by the mesenteric lymph glands; on the inferior border, by the adherent duodenum; and over the anterior and superior border by the flattened pancreas.

Microscopically, as macroscopically, the hypertrophied wall of the superior mesenteric can be followed but a short distance from the aorta. Microscopically the muscular wall terminates rather abruptly and its elements cannot again be identified to a certainty, although there are sweeps of fibers with long, delicate nuclei scattered throughout the wall, which cannot always be identified as sympathetic nerve elements.

The peripheral light-colored portion of the wall shows fibrous tissue interspersed with such elements as one would expect to find in the wall of an expanding sac in this region. Areas of fat usually arranged in layers; and in portions of the wall the ganglia and nerve bundles of the sympathetic system are conspicuous. Lymphatic glands and vessels are seen; and, in the localities mentioned above, tissues of the duodenum and pancreas.

The inner red layer of the ante-operative portion consists of the same variety of tissues as the outer, together with a great admixture of blood elements. The picture is one of dissection of the wall by the force of the blood stream. The strands of fibrous tissue are often in a state of hyaline degeneration, probably due to their separation from a good blood supply. The capillaries of this region, although not numerous, possess cells with swollen nuclei and are rather conspicuous; but Professor Weleh, who kindly examined some of the sections, classes them with the displaced tissues rather than products of an attempt at organization, it being a characteristic of aneurism clots not to organize.

The post-operative portion of the aneurismal wall (c) consists of an ante-mortem blood-clot, in the center of which can be seen the ends of the wire cut across on sectioning the aneurism. The position of the wire in the former lumen of the sac and its relation to this solid blood-clot shows the efficacy of the method, had the case been one anatomically favorable.

On making a lateral section from the first median incision and extending towards the duodenum, we find that the outer fibrous-like wall is entirely wanting at the point where the oozing took place into the duodenum, and the blood-clot within the aneurism lies in immediate contact with the blackened necrotic duodenal wall. The lumen makes in towards the duodenum at this point, but there is 2 cm. of ante-mortem clot separating the lumen of the sac from that of the duodenum. The process of fatal bleeding must have been an ooze, but the giving way of the necrotic duodenal wall was imminent.

CASE III (Case XXI).—J. T., a sea captain, aged 51 years, was admitted to the service of Dr. Osler on April 24, 1899, complaining of pain in the right chest.

His family history was good. His personal history was negative, except for very hard work at sea until within a few years.

His pain began 7 months before admission and had gradually increased. Dyspnoea began in February, 1899.

On physical examination dilated veins were seen over the whole chest and abdomen, being most prominent on the right. The whole sternum was lifted with each systole, while to the right, between the second and third ribs, could be localized an area of maximum impulse. Here a systolic murmur could be heard and a diastolic shock felt. Expansile pulsation was pronounced. The heart was negative. The right lung on percussion gave a dull note throughout the right front and in the axilla, and distinct impairment of resonance existed in the right interscapular region.

The patient suffered great pain over the entire right chest and toward the right shoulder.

His condition grew worse and, on April 25, gelatin injections were begun, the patient receiving 250 cc. of a 1 per cent solution

subcutaneously. After 9 injections of a 1 per cent solution, the strength was doubled. Between April 25 and July 27, 17 injections were given, with the result of lessening his pain and reducing the force of his pulsation.

On August 11, Dr. Finney operated, passing into the sac 10 feet of the silver wire alloyed with copper, drawn, and prepared as described in the above report on Dr. Finney's first case. The galvanic current was applied for 1 hour at 10 ma., and for 15 minutes at 20 ma.

Cocaine was injected over the point to be punctured. After loading the needle with wire, the skin was drawn to one side and the needle inserted pointed toward the right portion of the sac. After passing through the skin and about 2 cm. of subcutaneous tissue and muscle, a few drops of sanguinous serum came through the needle. After this the needle was felt engaged in a solid substance for about 2 cm., when it suddenly broke through and a stream of arterial blood spurted with each heart-beat. The wire was easily passed within 5 minutes and the end attached to the positive pole of the battery. Throughout the session the patient felt a slight sticking and burning within the chest, and for the first 20 minutes a sensation as of something moving from side to side. After 40 minutes a current of 20 ma. was tried, when the burning sensation increased. The current was immediately reduced to 10 ma. After an hour the burning sensation ceased and the current was increased to 20 ma. for 15 minutes, causing no sensation to the patient. On withdrawal of the needle a slight flow of blood through the puncture wound was readily controlled by a few moments' pressure with a gauze sponge. Wound dressed with silver foil and adhesive strapping. The pulse, usually about 100 to the minute, beat at 110 to 112 during the operation.

The patient's condition, which was not bad for a week before the operation, seemed to change very little after the operation. On the third day he stated that he could no longer feel a pulsation while lying on his right side, and during the previous night he noticed for the first time that the pulsation was not so strong when lying on his back.

After a week the pulsation was as marked as before the operation, and seemed shifted somewhat to the left of the original site. His pain began again, and on the twelfth day the gelatin injections were again begun.

The patient was dismissed September 22, having had 16 gelatin injections after his operation. His condition was much improved, the pain having ceased and the wall of the sac manifestly thicker. The effect of the wire in this case seemed to be a partial filling of the large sac, causing extension toward the left. There can be no doubt that the gelatin injections were very beneficial in this case.

Patient returned September 30 because of shortness of breath on the slightest exertion, he having had no pain during the week at home.

On October 16 the patient went home, after several gelatin injections, his condition being about the same. He recovered sufficiently to again take up active work in the refitting of a steamship, and whenever seen he always claimed to be perfectly well. He sailed as captain, and on the arrival of his ship at Bahia, Brazil, a cablegram was received at Baltimore, announcing his death and burial at sea on February 14, 1900. It is highly probable that death was due either directly or indirectly to his aneurism.

CASE IV (Case XXII).—J. F. G., a steam-shovel tender, aged 39 years, was admitted, October 9, 1899, to the service of Dr. Osler, complaining of pain in the chest, a dry hacking cough, and shortness of breath. His family history was negative. His personal history included gonorrhœa and possibly syphilis. He had been a heavy eater and moderate user of alcohol and

tobacco. Until within a few years he had been subject to heavy work and much exposure.

His present illness began about 18 months ago with sharp spasmodic pains in the chest, lasting 15 to 20 minutes. These attacks were almost daily and often recurred several times during a day. At times, during the early history of his trouble, he had attacks of suffocation and feeling as though about to die. The attacks of pain increased in frequency, and for the past 5 months the pain has been continuous.

About 5 months ago bulging was noticed over the painful area on the right side of the chest; and, a skiograph being taken, his trouble was pronounced aneurism.

On admission, the patient was obliged to keep a half-sitting, half-reclining posture, and suffered a varying degree of cyanosis and dyspnoea. His pupils were equal and reacted to light and accommodation. The voice was husky and he was subject to a dry hacking cough. The pulse was slightly irregular and distinctly collapsing, there being no appreciable difference in time of the radials. No tracheal tugging.

The thorax was less expansile on the right side. On the right side, extending from the right mammary line to the median line and from the second rib to the costal margin, there was an area of bulging and pulsation. At the right sternal border in the fifth interspace there was a small area of unusual prominence, excessively tender to the touch and presenting a pulsation of maximum intensity. Here the pulsation was vigorous, expansile and close to the fingers. A diastolic shock could be felt and a diastolic murmur heard over this area.

The heart was somewhat displaced downward and to the left. A soft diastolic murmur was audible at the apex and over the aortic area. The other sounds were clear. The second pulmonary was accentuated.

The liver extended 7 cm. below the costal margin in the mammary line. There was well-marked movable dullness on the right side and a friction rub in the interscapular region.

From the time of admission the pulsation and prominence of the area in the fifth interspace continued to increase. The patient suffered frequent attacks of shortness of breath and cyanosis. During the first three weeks the right pleural cavity was aspirated three times, a half-liter or more of a clear, serous fluid, slightly blood-tinged, being withdrawn each time. A diagnosis was made of aortic aneurism, probably springing from the ascending arch near the heart, possibly coming from the descending thoracic portion.

On October 27, Dr. Finney operated, passing 10 feet of silver wire (alloyed with copper, drawn, and prepared as described in Dr. Finney's first case), and galvanizing this with 10 ma. for 1 hour. The excitement incident to the preparation for operation resulted in a marked attack of dyspnoea, and amyl-nitrite was used for inhalation. The patient was allowed to keep the upright position in his wheel-chair. A fine aspirator needle loaded with wire was introduced in a direction downward and to the right.

It was our intention to introduce a second needle and play in a second 10 feet of wire, but just as the first spool was exhausted the wire offered decided resistance and the patient said he could feel a grating sensation within. We took these two circumstances as evidence that enough wire was passed.

The patient volunteered the information that he could feel a 5-ma. current, and after five minutes that he felt the change from 5 to 7 ma., and again the change from 7 to 10 ma. During the hour at 10 ma. the patient had occasional slight burning or prickling sensations within his thorax; and the metal plate wrapped with a wet towel had to be changed once because of the burning sensation at the back.

At the close of the operation the expansile character of the pulsation had disappeared, while the heaving was still present.

The patient slept during most of the afternoon following

operation, and for 15 days the condition of his aneurism improved markedly. His general condition was kept at a low ebb because of the repeated filling of his right pleural cavity, which was aspirated every few days up to the time of death.

On November 15, Dr. Osler noted that the tumor was increasing in size, and on November 20 rupture seemed so imminent that Dr. Finney again wired the sac, this time passing 11 feet of wire and galvanizing as before. Again the improvement was decided but only temporary.

The patient was wired the third time on December 8 (11 feet being passed), and on the 29th an incision was made through the thinned and necrosed skin for the drainage of a large collection of sanguino-purulent material which had appeared in the extra thoracic tissues over the site of the aneurism.

The aneurism was now deep-seated and the symptoms of increasing shortness of breath, hæmoptysis, and venous engorgement of the head region indicated an extension backward. The patient had very little pain from the time of admission and anodynes were given, more for sleeplessness.

On January 14, 1900, about 11 weeks after the first wiring, the patient died, with symptoms of pressure upon the trachea. Autopsy was refused.

CASE V (Case XXIII).—M. P., a sewing-machine agent, aged 30 years, was first admitted to Dr. Osler's service on October 31, 1899, complaining with what his physician had called "kidney and stomach trouble."

His family history and personal history were excellent, containing nothing to arouse a suspicion of arterial disease. His present illness began in March, 1899, with the gradual onset of intermittent pains of a burning and gnawing character located in the stomach region. These pains seemed to have no association with the taking of food. Within a month his suffering became so intense that he was forced to bed, where he remained for 3 months, requiring the continued use of morphia injections.

The pain was of a boring character, seemed central in the epigastric region, and radiated in every direction, being especially severe in the back and often shooting into the scrotum. During this 3 months he had some nausea and suffered 6 attacks of vomiting, during one of which he thought he would die. His appetite and general condition were good. He lost some weight. His bowels required the constant use of laxatives.

In July he became enough improved to leave his bed for a portion of each day, but the slightest exertion increased his pain.

In this condition he entered The Johns Hopkins Hospital and remained for 3 weeks in November.

Physical examination revealed nothing of moment except the condition of the abdomen. This was fairly normal in appearance; the costal grooves, however, being slightly less marked than usual. The iliac grooves and lumbar lines were equal and symmetrical on the two sides. Both hypochondriac regions were pigmented as a result of blisters. The epigastric region was slightly full and showed marked visible pulsation. Here there was extreme sensitiveness to pressure, with distinct resistance on deep palpation. No definite expansile pulsation could be made out at the first examination. On percussion there was dull tympany over the pulsating area. No thrill could be felt. There was a very faint systolic bruit. With the patient in the knee-elbow position, no pulsation could be felt except on deep palpation. Pulsation seemed equal in the femorals. In the back there was no bulging on either side of the spinal column, no pulsation, no bruit. Six days after admission, Dr. Osler noted that with deep palpation a definite expansile pulsation could be determined, and with deep pressure on the left side the sac could be felt.

During his 3 weeks in the hospital, the patient suffered severe pains across the upper abdomen, extending especially along the

right costal margin. This pain was often relieved by pressure from without, or by the patient lying on his left side with his head lowered.

After 2 months at home, the patient re-entered the hospital, January 14, 1900, having decided to undergo the operation advised. He had lost 6 pounds in weight since leaving the hospital. The pains had increased in his lumbar region, and for 3 weeks past he had experienced a burning sensation in his knees and ankles.

Operation (January 26, 1900; Dr. Finney).—Celiotomy; passage of 8 or 9 feet of highly drawn sterling silver wire; galvanism for one hour at 10 ma.

The conditions found in Case II were almost exactly duplicated in this case. The pulsating mass was covered over its lower portion by the stomach, over its upper portion by the pancreas, and the large splenic vein traversed its convex surface. The procedure was the same as in Case II, except that section of the very hæmorrhagic pancreas was avoided by drawing the liver to the right and making the puncture in the upper right quadrant of the sac. The patient bore the operation well, his pulse ranging about 110 beats to the minute. At the close of the electrical séance there was no appreciable difference in the pulsation of the sac. This fact, together with the anatomical relations of the mass, made it seem very probable that the aneurism was one of the superior mesenteric artery, as in Case II. Except for middle-ear trouble, the patient's convalescence was uneventful. He was very happy over the marked improvement in his symptoms, insisting that he must be getting well because of the slight amount of pain compared with his former condition. But there was no appreciable improvement in the physical signs. On the day of his discharge, March 8, Dr. Osler made the following note: "Patient says he suffers less pain. He looks well. Pulsation chiefly seen in the epigastric region and appears a little more diffuse than formerly. On palpation the pulsation is most intense just below the ensiform. The tumor is still well felt on deep lateral pressure. No thrill felt. A soft systolic bruit is heard. No pulsation or murmur behind."

It might be argued that the current of 10 ma. was not sufficient in this case. But I am satisfied from the history at and since the operation that this was a case of fusiform aneurism, probably of the superior mesenteric artery, and its outcome is another argument in favor of the weaker current when we compare the results with Case II, which barely escaped an infarct of the whole small intestine from the sudden closure of the superior mesenteric artery.

Dangers.—Needless to say that sepsis is an omnipresent danger, especially in these cases characterized by large non-vascularized accumulations of blood and fibrin, and all details of surgical cleanliness should be strictly carried out.

One of the greatest dangers in this procedure, particularly in the large multilocular aneurisms, is the development and rupture of a secondary sac due to the rapid filling of the main sac by coagulum and the shunting of the blood stream against a portion not receiving a special strain before. Apparently this occurred in the cases of Domville, Cayley, Ransohoff, Hulke, Barwell, and in Stewart's first case. Loreta's unique case of rupture of the aorta at its juncture with the base of the former aneurism was probably caused, as he suggests, by lack of nutrition to the wall due to changes in the circulation brought about by contraction of the organizing sac. General arteriosclerosis would weigh against operation.

The chances of a loop of wire entering the aorta seem less than one would a priori suppose. Moore expresses surprise

that in his case, with large openings in the second and third interspaces connecting the extra- and intra-thoracic sacs, no wire entered the inner sac. The accident has occurred in three cases upon which autopsy has been held. In Ransohoff's case the aneurism of the ascending arch was very large, 4 x 7 inches, and its opening into the aorta was comparatively small, 1 inch in diameter; yet a loop of wire left the sac and descended low enough to interfere with one of the valves, causing syncope that for a few moments threatened death. In White and Gould's case the opening from the sacular aneurism into the large fusiform aneurism of the aorta easily admitted four fingers. A loop of wire entered the fusiform dilatation causing no symptoms. Reeves's case, which, from the report, seems to have been an ideal one for this method, possessed only a small opening from the perfect sac low down on the abdominal aorta. Through this opening the first end of the wire passed into the aorta and up to the aortic valves probably causing the syncope as in Ransohoff's case, and later a loop entered and passed up the aorta a distance of 10 inches. In none of these three cases was the character of the wire or its previous treatment such as to make probable its coiling after entering the sac.

One would suppose that a loop of wire in the aorta would whip out fibrin and present a menace in the form of emboli, but nothing is said of fibrin in any of these cases, while in the large fusiform aneurism of Kerr (his first case), where electricity was used, there was found a firm clot around the wire and on the walls. The wire had taken a position in the anterior portion of the sac and may have been out of the direct aortic current. In Stewart's third case there was no clot about the wire which had been in the fusiform aortic dilatation five days. While clinical experience shows that wire without galvanism will collect fibrin in the lessened current of a sac, it is probable that it will not do so in the active aortic current (see our last dog experiment). But our dog experiments demonstrate that wire with galvanism separates the fibrin even in an aortic current which is but little reduced, and in these cases in which the wire has entered the aorta and is found fibrin-free at autopsy we must believe that fibrin was formed during the electrical séance to be brushed off later and become a menace to life.

The size of the sac opening cannot be diagnosed from the character of the bruit although it is generally held that a double systolic and diastolic bruit is indicative of a small opening. Against this theory see Halsted's case.

Another danger is that of emboli breaking from the sac wall during or after the insertion of the wire. This may have been the cause of death in Roosevelt's case. No autopsy was held.

Halsted's case and Finney's first case bring up the danger of closing important vessels by the sudden filling with clot of an abdominal aneurism. Litten¹⁵ by his clinical and experimental research demonstrates that sudden closure of the superior mesenteric artery can have but one result; namely, hæmorrhagic infarct from the lower end of the duodenum to the middle of the transverse colon.

We have mentioned the possibility of puncture of the sac wall especially on passing steel wire. But this danger is more theoretical than real, for the wire begins to coil soon after leaving the needle and is almost sure to impinge on the sac wall with a segment of a coil rather than with its sharp end.

Loreta suggests the danger, in abdominal aneurism, of the sac giving way when the abdomen is opened, and the support of the abdominal walls thus removed.

Failure might result, particularly in aneurism of the thorax, because of the presence of a double sac, both intra-thoracic, as in the cases of Domville and of Corson, or one intra-thoracic and one outside the ribs as in the cases of Moore, and White and Gould; or one might successfully treat a sacular dilatation of the aorta, and still be confronted by a failure because of the presence of a fusiform aneurism. Such anatomical conditions were found in the cases of Domville, Cayley, and White and Gould. Failure in Hare's first case (Case XV), the fifth case of Stewart (Case XIX) and in Finney's second and third cases (Cases XXI and XXII) was possibly due to the insufficient filling of a large single sac; but it is more probable that each of these cases possessed a multilocular sac and the gradual extension was due to bulging of unfilled loculi.

Failure must be expected if an error in diagnosis be made and a fusiform sac be treated—as in Stevenson's case, Kerr's first case, Stewart's third case, Finney's first case, and Corson's case.

Results.—Do the results so far obtained justify a continuance of this method? With Moore's method of wire alone we see that 14 cases have been treated, 8 thoracic and 6 abdominal. Two of these, Morse's and Langton's cases of abdominal aneurism, resulted in cure. Loreta's case of abdominal aneurism resulted in cure of the aneurism but unfortunately the patient died three months later from rupture of the aorta. In all but four of these cases, those of Murray, Loreta, and Morse and Langton, it is definitely stated that the patient was in a desperate condition and it is a matter of speculation how much death, occurring in from one day to one month after operation, was hastened. Rubio's case was lost sight of after four days. Lange's case had already ruptured before treatment. Of the remaining nine, not counting Loreta's, Morse's and Langton's, we get the impression that death was hastened in four, those of Moore, Hulke, White and Gould, and Stevenson. Autopsy was held in nine cases and in all the effect of the wire in whipping out fibrin was marked.

With the combined method (Moore-Corradi) there have been 23 cases, 17 thoracic and 6 abdominal. Four of these, or 17 per cent, 3 thoracic and 1 abdominal, were cured. Here we must speak with reserve, for knowledge of the living patient or proof gained by autopsy are at our command for but two of these cases. Rosenstirn's patient after 11 years is alive and well. Stewart's second case was one of definite cure as shown by autopsy more than 3 years after operation. It seems fair to consider Kerr's second case cured. He left the hospital two months after operation, with every indication of

having been cured, was watched at work as street paver for 10 months and then lost sight of, although he promised to return should he ever have more trouble. Noble's patient lived 8 months with no signs or symptoms of his abdominal aneurism and died from an entirely different cause.

Nine cases, or 39 per cent, attest the value of the operation by amelioration of symptoms and prolongation of life. Here again we must not be too sanguine, for in any given case we cannot prophesy as to his length of days or degree of suffering if there be no operative interference. Buresi's case was greatly relieved but soon died, 3¼ months. Hershey's case, apparently cured, returned to his very active work as mining prospector, and had no trouble until 12 months after operation, when the symptoms of aneurism again developed and he died from rupture two months later. Stewart's fourth and fifth cases were decidedly improved, one living 8½ months and the other 9 months after the first operation. Hare's first patient enjoyed comparative comfort for 6 months after operation but died at the end of 7 months. His second case lived 7 months after the first operation and Dr. Hare says there can be no doubt that his life was prolonged. Finney's second case improved so far that he considered himself cured and resumed active life as a sea-captain. He died 6 months after operation. As nearly as one can judge, the life of Finney's third case was prolonged as a result of 3 operations, although he lived but 11 weeks after the first operation. His fourth case is still living with great improvement in his subjective symptoms.

Death was probably hastened in the remaining ten cases: Barwell, 7 days; Roosevelt, 23 days; Abbe, 2 days; Kerr, first case, 18 days; Stewart's first and third cases, 9 and 5 days respectively; Halsted, 2 days; Finney, first case, 20 days; Corson, 2 days; Reeves, 24 hours.

Clinical and post-mortem evidence points to the efficacy of this method. Its great drawback is the difficulty of accurate diagnosis. If we consider that none of these cases were picked as being favorable for operation; but, on the contrary, that they were almost without exception considered hopeless cases, I think we are forced to give the method careful consideration. The fact that the method is still in its infancy and in many instances most crudely applied makes the record still more impressive.

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DISCUSSION.

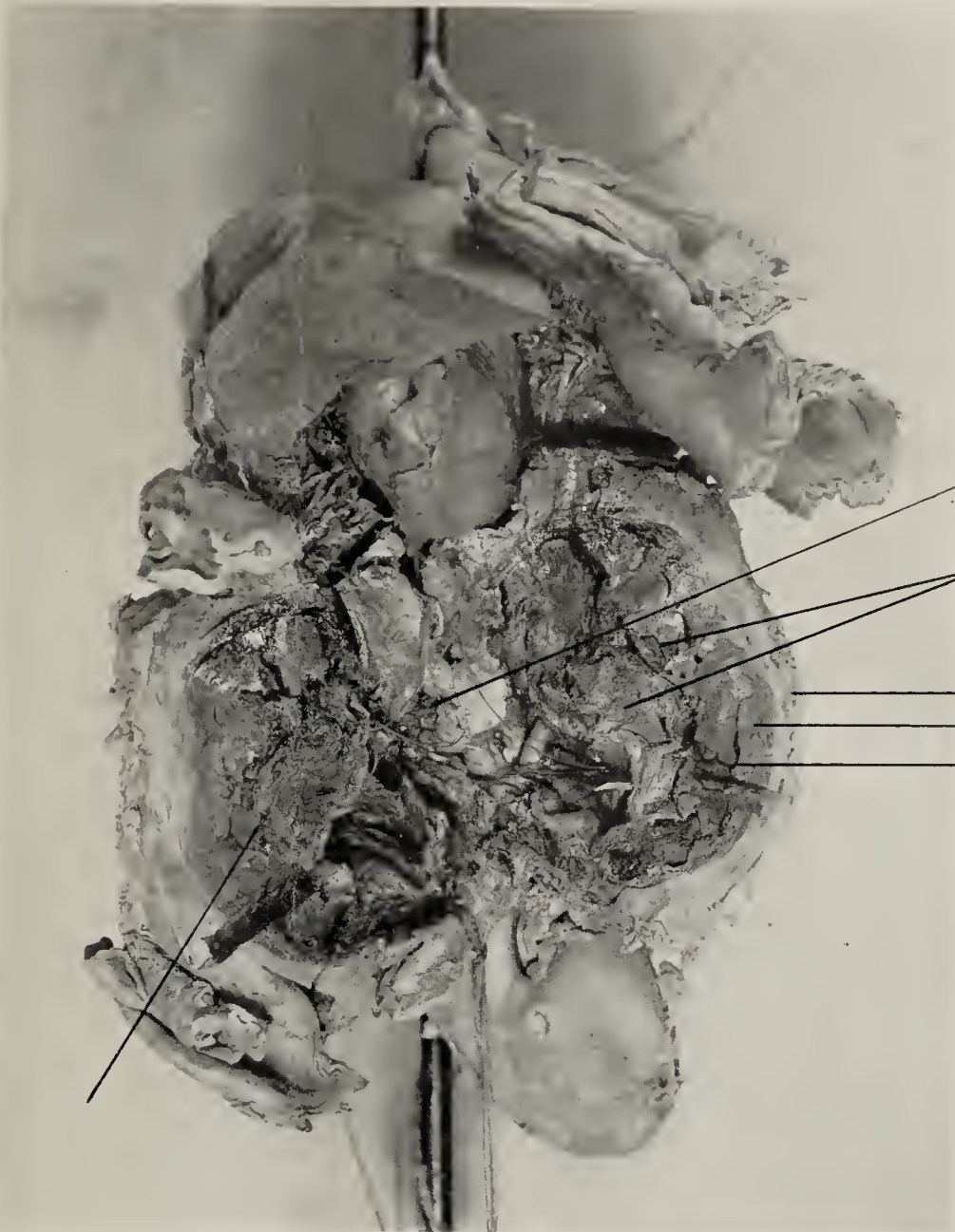
DR. OSLER.—Demonstration of Dr. Finney's third case (Case XXII) after his first operation. On admission this man presented a very remarkable picture. He had a pulsating area in the inframammary region close to the sternum, and a right-sided effusion. We were in some doubt at first whether it was not a case of pulsating pleurisy, but the pulsation persisted after withdrawal of the liquid and it gradually became more localized, and began to project. There was a loud bruit over it, which was transmitted to the back. Dr. Finney wired it and since the operation the local condition has improved. The redness has disappeared, and the impression of both heart shocks, the systolic and diastolic, which could be felt upon the slightest touch of the finger, is no longer present. The tumor has become harder and altogether the signs indicate that there is coagulation going on in the sac.

DR. FINNEY.—The fifth case of Dr. Stewart's was a patient of Dr. John Neff, of Baltimore, whom I had seen in consultation. We had arranged to have him enter the hospital here for wiring, when some kind friend, very wisely no doubt, advised him to go to Philadelphia to Dr. Stewart. He has operated upon him three times with temporary benefit, after each operation. As Dr. Neff is present, perhaps he can tell us something about the case.

DR. NEFF.—I shall be very glad to furnish what information I have of the case. This gentleman's trouble was detected about three years ago and he was given a thorough iodid treatment with as much rest as we could enforce. There was some benefit resulting and he resumed his occupa-

a Extreme peripheral wall—compact fibrous portion—showing, in different regions, incorporation of nerve elements, blood vessels—thrombosed and patent, lymph glands and vessels, fat tissue.

b Looser red portion of wall, showing the same tissues as (a) being separated by the blood elements.



Dilated mouth of sup. mes. artery.

C Newly formed clot with wire zone in center.

A Whitish fibrous portion. } False arterial wall.
B Red portion. }

Wire ends.

Aneurism—Fusiform—Superior Mesenteric Artery. Path. No. 1144.

C Newly formed clot with wire zone in center, opposite the letter c.



1.

2.

3.

1. 9 ft. pure silver wire. Drawn from No. 8 to No. 27.
2. 11 ft. silver (copper alloy $\frac{75}{1000}$) wire. Drawn from No. 8 to No. 27.
3. 11 ft. steel wire.
Each boiled on its spool for 15 minutes and then passed through cannula. Note the closer coil of 2.

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tion, that of traveling salesman, again, but after a while came back worse, and I advised an operation, as I had read the report of Dr. Stewart's cases. He had some relatives in Philadelphia who advised him to consult Dr. Stewart, because he had done so many of these operations. I was present at the operation and Dr. Stewart introduced 12 feet of wire. The evidences of clot were very manifest, and you could not hear the bruit so directly in front as before the operation. He was subjected to a very rigid diet and absolute rest, remaining on his back for four weeks, not even elevating his head, and ice was applied over the region of the aneurism. At the end of that time he was allowed to walk around carefully but was kept in the hospital 8 weeks longer.

He seemed considerably benefited when he came home, but after awhile there appeared another point of protrusion and he went back for another operation. He remained under observation for one month, and then, another protrusion pre-

sented itself, he was again operated on. I saw him only last week, just before starting for Philadelphia, expecting to have to be operated upon again, as there are two protrusions now. He is suffering from pressure on the trachea, also, and cannot take anything but liquid food. I do not believe he can live very long in the condition in which I saw him last, and I do not see how anything can be done now that will prolong his life to any extent. He had suffered intense pain before the first operation, but while the suffering has been ameliorated there has been no permanent success attending the operations.

DR. OSLER.—Aneurism of the aorta is so hopeless that it is very encouraging to hear Dr. Hunner's paper, particularly on the question of increasing the perfection of the technique. In the natural method of cure in aneurism gradual depositions of fibrin take place at the surface of the sac, and with a perfect technique, entailing a minimum of risk, repeated operations could be performed.

OBSTETRICAL PARALYSIS, INFANTILE AND MATERNAL.¹

By H. M. THOMAS, M.D.,

Clinical Professor of Neurology, Johns Hopkins University; Neurologist, The Johns Hopkins Hospital and Dispensary.

The force which is required to complete the act of parturition is, at times, a source of danger to the peripheral nerves of both the mother and child. It is to some of these traumatic cases of obstetrical paralysis that I wish to refer in this communication.

I have seen five such cases during the present year. Two occurred in mothers and three in babies; in one instance a mother and baby were paralyzed at the same labor.

This experience, which was unusual to me, interested me in these cases, and I trust that a short abstract of the histories may not be out of place at this meeting.

Duchenne's obstetrical paralysis of the arm in infants is not very uncommon and we are all familiar with its characteristics. Much has been written about it, and I should not presume to speak of it here were it not that some recent work has been done on the subject from the standpoint of the obstetrician that may be as new to some of you as it was to me.

Before referring more fully to this recent work, I shall give as a standard of contrast a free translation of Duchenne's conclusions.²

"Certain violent obstetrical measures, which may be necessary during the difficult lowering of the arm after the body of the infant has been born, or the strong traction on the shoulder by a finger introduced in the shape of a hook into the axilla, after the head has been born, may at times produce a paralysis of the arm, localized in the deltoid, the infraspinatus and the flexors of the forearm and characterized by the falling of the arm close to the side of the body, the rotation of the arm inwards and the extension of the forearm on

the arm. The prognosis of this paralysis is, in general, grave; it may be cured by local faradization, but if this is abandoned, it becomes incurable and produces atrophy of the member."

Erb³ speaks of the similarity of the cases described by Duchenne to those in which the brachial plexus is injured in adults. He confirms Duchenne's clinical picture and points out that the injury is to the 5th and 6th cervical roots, probably at the point in the neck, the stimulation of which by the electrical current causes a contraction of the muscles involved in this form of paralysis. This, the often-called Erb's point, he describes more accurately in his *Handbuch der Elektrotherapie*, 2d edition, 1886, p. 305.

"A point can be discovered from 2 to 3 cm. above the clavicle and somewhat outwards from the posterior border of the sternocleidomastoid muscle, and just in front of the transverse process of the 6th cervical vertebra, the stimulation of which causes a simultaneous contraction of the deltoid, biceps, brachialis internus and supinator longus muscles (apparently usually also of the infraspinatus and subscapularis)."

Erb thought that the plexus might be injured by many forcible obstetrical procedures, but he blamed particularly the so-called "Prager Handgriff," in which the finger is placed above the clavicle and pressure made directly over the point that he described.

After this it was generally believed and taught that this form of paralysis was due to pressure on the brachial plexus at Erb's point. Why such varying conditions as are known to produce the paralysis should always make pressure at just this point, was not explained.

¹ Written for the American Neurological Association, 1900.

² De L'électrisation localisée. 3d edition. 1872, p. 361.

³ Ziemssen's *Handbuch*. Bd. XII. 1ste Hälfte, 2te Auflage, 1876, p. 529.

C. F. Carter⁴ advanced, for the first time, the theory that the stretching of the upper roots of the plexus and not pressure on the plexus, in the great majority of cases, was the cause of these obstetrical paralyses. He arrived at this conclusion from his inability to explain the cases by any of the accepted hypotheses, and not from any dissections or experiments.

G. L. Walton⁵ in his interesting paper on the Etiology of Obstetrical Paralysis, speaks of the unsatisfactory character of the explanations of the causes of this paralysis. Carter's theory he considers the best, although he would expect paralysis of the pectoralis major, if the plexus were injured where Carter supposed; but, on the other hand, if the plexus were injured by pressure against the clavicle, as Oppenheim supposed, the scapular muscles ought not to be affected.

Walton dissected the brachial plexus and found that the suprascapular nerve is given off high up and runs independently; so he thinks it must be injured separately, probably by pressure either against the suprascapular notch, or against the outer edge of the scapular spine.

Walton lays stress on rotation of the child's head combined with traction, as an important factor in the production of these paralyses. He, in association with Dr. J. J. Thomas, made some experiments, which for some reason were not conclusive, except in one regard, which I quote from the original:

"One point of interest we have established, however; namely, that when the body is placed in the position suggested, with the face rotated and the head forcibly drawn away from the shoulder, the clavicle is brought up sharply against the dorsal curve of the first rib. This point of contact is, therefore, the probable seat of injury of the brachial plexus, excepting the suprascapular branch."

If I have understood Dr. Walton rightly, his belief is that the nerves are stretched against some resisting point, the edge of the clavicle, and the suprascapular notch for instance, and so injured.

Fieux,⁶ in 1897, apparently without knowledge of the work that had been done in Boston, laid great stress on the stretching of the brachial plexus as the cause of this paralysis. He made dissections and experiments to show that it was the upper roots of the plexus that were most stretched, and particularly so when the head was bent laterally. Indeed, he was able by this maneuver to actually rupture the 5th and 6th cervical roots.

Fieux thought that the experiments that he did, showed that it was impossible to constrict the plexus between the clavicle and the spinal column, or to injure the nerves by the application of forceps.

He will not admit that any other factor takes part in the causation of obstetrical paralyses, and explains them all by an undue traction on the neck with lateral flexion.

Cibert,⁷ in an excellent thesis, written in the same year,

but after the publication of Fieux's article, reviews the whole subject and gives many references to literature. He refers to Carter's, Walton's and Fieux's papers, and accepts the theory of stretching as explaining the great majority of cases. He is, however, not so positive as Fieux in his statement that traction on the upper roots of the brachial plexus is the only possible cause of such paralyses. Cibert concludes his article with an excellent table of seventy-six cases which he found in literature.

Schoemaker of Nymwegen,⁸ after a short report of two cases of obstetrical paralysis, reviews the subject, especially in relation to Fieux's article. He repeats the experiments made by this author, and, for the most part, confirms his results. Schoemaker found that if the neck be stretched in the direction of the axis of the body, the upper roots of the brachial plexus are put upon a certain amount of tension; that if during the traction the head be bent forward or backward or rotated, this tension is not materially increased; but if the head be bent laterally, the tension becomes very much greater, the fifth root being most stretched, the sixth next, the seventh and eighth much less. Schoemaker was not able to rupture the fifth and sixth roots in the alcoholic specimen.

He was able to constrict the 5th and 6th roots of the plexus by compressing the shoulders and pressing them upwards. This was more easily done if the arms were elevated above the head. The constriction occurred between the clavicle and the transverse process of the sixth cervical vertebra. It was so great as to make an indentation in the nerve roots. With forceps he found that it was not easy to compress Erb's point; indeed, he believes that it is not possible if the forceps are applied nearly in the direction of the axis of the body, but that it may be done if the forceps are applied at an angle of about 30 degrees. That the finger of the obstetrician may at times injure the brachial plexus at Erb's point he thinks is possible, although he believes it must occur very rarely.

Schoemaker shows how these various conditions may occur during labor, thus: In head presentations, the first danger is from pressure by the clavicles. This is slight, except in the few cases in which the shoulders are compressed and pressed towards the head. When the head is born then it is possible with the woman on her back, and the head hanging over the perineum, that the plexus may be so stretched as to be injured. If the head is grasped and traction is made with the head bent toward one shoulder, there is then great danger of overstretching the plexus. If the shoulders are still not born, and the finger is put in the axilla, and strong traction made, then it is possible that the clavicle may be raised and compress the plexus against the spinal column.

In cases in which it is necessary to use forceps, Schoemaker thinks that the danger here is also from stretching the plexus, although he admits that in certain cases the forceps themselves may injure the nerves. Very strong traction in the axis of the body may cause such a stretching as to injure the

⁴ Boston Medical and Surgical Journal, May 4, 1893.

⁵ Boston Medical and Surgical Journal, Dec. 24, 1896.

⁶ Annales de Gynécologie, Tome XLVII, 1897, p. 52.

⁷ Lyon Thesis, 1897.

⁸ Zeitschrift f. Geburtshülfe u. Gynaekologie, Bd. XLI, Heft 1, 1899, p. 33.

nerves, although this is much more apt to occur when the head is bent laterally.

In breech presentations, the shoulders are often constricted and pressed towards the head, and it is in these cases that the plexus is most apt to be constricted between the clavicle and the spinal column. The danger is greatest when traction is made on the body and the arms are above the head. If the arms are born and traction is made by the fingers above the clavicles to deliver the head, it is possible to injure the plexus by direct pressure, but here again Schoemaker thinks that the chief danger is in stretching the nerve roots.

He finds in literature ninety-five cases of typical Duchenne paralysis in which the mechanism of labor is more or less accurately determined. Sixty-six of these cases he takes from Cibert's theses.

Of these ninety-five cases, fifty-five were head presentations. In ten of these labor was spontaneous; eight times the head was pulled upon with lateral flexion; ten times it was necessary to make traction with a finger in the axilla. In twenty-eight cases forceps were applied.

In forty cases the breech presented. In six of these the birth was spontaneous, but in thirty-four the child had to be extracted; of these last one or both arms were noted as being raised in thirteen cases.

Schoemaker thinks that if the dangers which occur at the various stages of labor are recognized, and the proper procedures are taken to meet them, very few cases of obstetrical palsy will occur.

From the neurological standpoint, the chief interest in these paralyzes is the grouping of the muscles which are affected. Why should an injury to the brachial plexus cause a paralysis which is limited to just these muscles, the infraspinatus, the deltoid, the supraspinatus, the biceps, the brachialis and the supinator longus? These muscles are supplied from various nerves which in their turn arise from different cords of the plexus. It is difficult to imagine any point in the plexus an injury to which would cause such a paralysis: Erb recognized this and supposed that the lesion was to the 5th and 6th cervical roots, and that it was the stimulation of these roots at the so-called Erb's point that caused the contraction of the muscles named.

The 5th and 6th cervical roots, however, send fibers to many other muscles than those paralyzed in these cases; and, on the other hand, these muscles receive fibers from other roots. A reference to Wichmann's⁹ recent work will show how complicated the problem is and what very different views are held by the different investigators in this line.

It would seem to me that, although all muscles receive fibres from several spinal roots, that their movements are represented particularly in one or two roots, and that an injury of these special roots causes a paralysis of those muscles which are most represented in them. It seems fairly well determined that the muscles affected in obstetrical palsy have their chief representation in the 5th and 6th cervical

roots, and the experiments of Fieux and Schoemaker show that these roots are most apt to be injured during difficult labor, whether it is simply by the stretching of the plexus, or the squeezing of it between the clavicle and spinal column.

What are needed to clear up the question are careful post-mortem examinations, for we are almost completely without such data. Nonne¹⁰ reports the examination of a case in which the roots of the plexus were pressed upon by a tuberculous growth and in which paralysis of characteristic distribution resulted. Oppenheim¹¹ refers to having examined a case of obstetrical paralysis in which there was degeneration of the 5th and 6th cervical roots. These two cases, as far as I know, are the only ones in which autopsies have been made, and they do not settle many of the points in dispute.

The cases which I wish to report are the following:

CASE I.—Johns Hopkins Hospital, Dis. Nerv. System, No. 10,465.

Bernard C. Six weeks old. Is brought on account of his not using right arm. Mother has had four other children and three miscarriages.

Birth was at term. The labor began at six p. m., the head presenting. Chloroform was administered at 11 p. m., and the forceps were applied. After the birth of the head, which offered considerable difficulty, quite a long time elapsed before the birth of the shoulder. The right arm was born first and traction was made on it. Labor was complete at 2 a. m. The paralysis of arm was noticed soon after birth. (History obtained from grandmother.)

P. C. The right arm is held at side, the elbow is extended and the arm is rotated inward. There is no evidence of a fracture or a dislocation.

The muscles paralyzed are the deltoid and supraspinatus, the flexors of elbow and the infraspinatus.

The electrical examination shows a slow lazy response of the paralyzed muscles to a weak galvanic current.

This patient was found dead in bed with his mother when about nine weeks old. No improvement had resulted from the use of the galvanic current. We were not notified of the child's death for several days and no autopsy was made.

The second case I saw in consultation, and it illustrates very well the danger of strong traction on the head with lateral flexion of the neck. The notes which the attending physician has kindly sent me are as follows:

CASE II.—“The record I have in the case of Mrs. K. is as follows: 38 years old, 4 children, labors and puerperia always perfectly normal. Nothing of note as to present pregnancy. Labor occurred Nov. 21, 1899. Child in R. O. I. T. (*i. e.*, head present, back to the mother's right). Labor was perfectly normal up to the delivery of the head. External rotation of the occiput took place to the mother's right, thus bringing the bisacromial diameter of the child into the anteroposterior diameter of the pubes, with the left shoulder of the child under the symphysis and the right in the hollow of the sacrum. Labor was now arrested by the inability of the uterus to force the shoulders through the pelvis, and in order to save the child it was thought best to extract at once. This was done by grasping the head by the occiput and chin, and depressing it until the anterior shoulder slipped under the symphysis, when, by elevating the head, the other shoulder and body were delivered without much trouble.

⁹ Die Rückenmarksnerven und ihre Segmentbezüge, Berlin, 1900.

¹⁰ Deut. Arch. f. Klin. Med., Bd. XL, 1896, p. 62.

¹¹ Lehrbuch der Nervenkrankheiten, 2d edition, 1898, p. 320.

"It was necessary to make strong traction on the neck of the child to free the anterior shoulder, and in this maneuver the brachial plexus on the left side was probably stretched.

"The cause of the dystocia lay in the size of the child, the mother's pelvis being perfectly normal, 22.5, 28, 34, and 20.5."

I saw the baby first on Nov. 29. It was a remarkably strong and active child. The left arm hung to the side with elbow extended and extreme inward rotation. Movements of fingers and of wrist were retained. Extension of elbow was strong, while there was no evidence of any action in the flexors. The shoulder could not be abducted nor the arm rotated outward. There was paralysis of the deltoid, the supraspinatus, the infraspinatus, the biceps, the brachialis and the supinator longus. The electrical examination was not conclusive, as I was unable to get any response either in the well or the paralyzed arm with any strength of current that I thought it advisable to use. A hopeful prognosis was given and the nurse was told to use gentle friction.

The child was seen again on Jan. 5, when a little more than 6 weeks old. The condition then was practically the same as before. Persistent passive motion combined with massage of the affected muscle was advised and the arm was galvanized about once a week upon the occasion of my visits. I was never able to determine the reaction of degeneration. The improvement began at once and was first noticed in the flexors of the elbow, then in the deltoid and finally in the outward rotation of the arm. The child was seen for the last time on Feb. 9, and was then practically well.

CASE III.—J. H. H., Dis. Nerv. Syst., No. 10,804.

Maggie C., 8 weeks old. Patient is brought by mother, who is under treatment for obstetrical paralysis of legs (Case V). The child's left arm has been paralyzed since birth.

The patient is the first child and is said to have weighed 12½ lbs. at birth. The mother has a contracted pelvis.

The labor was at term and was very difficult. The head presented. Forceps were used and had to be readjusted 6 or 7 times before the head was born; the shoulders then became fixed and traction was made on the head with the neck flexed towards the right shoulder. (The mother's sister, who gave the account of the labor, seems sure in regard to this.) The child did not breathe satisfactorily for some time after birth. There were bruises on the head and on the left side of the neck just below the ear.

P. C. There are no evident scars in neck. There is no fracture or dislocation about the shoulder joint. The left arm is held in the characteristic position, close to side, extended at elbow and rotated inwards. The wrist and fingers are moved voluntarily. The paralysis is of the deltoid, infraspinatus and flexors of the elbow. Electrical examination did not reveal the reaction of degeneration.

The child was ordered passive movements, massage and the galvanic current. The improvement was marked from the first, and the child, when seen last in June, 1900, was practically well.

In these three cases the head presented. Forceps were used twice. The cause of the injury to the brachial plexus can be determined definitely in only one case—the second. Here the only forcible procedure, in an otherwise easy labor, was traction on the head with strong lateral flexion of the neck, and the injury was surely due to stretching of the nerve roots. In the first case, where forceps were used to deliver the head, the right arm was next delivered and traction was made upon it, which may have elevated the clavicle so as to compress the roots between it and the vertebral column. It is also probable that traction was made on the

head, thus stretching the plexus. In the third case, where forceps and great force had to be used to deliver the head, it is conceivable that the blades of the forceps may have pressed upon the plexus. But here again strong traction with lateral flexion of the head was necessary to deliver the shoulders, and it is probable that it was this procedure that produced the paralysis.

The result in the two cases that lived was very satisfactory, but unfortunately such is not always the case, and I have seen a number of cases that have persisted until adult life.

The prognosis must, of course, depend upon the severity of the injury.¹²

The nerves of the mother may also be injured by traumatism during labor. This has been recognized for a long time but the occurrence is not common and not much has been written about it. In books on obstetrics it is often not mentioned and in neurological books, traumatism during labor is usually simply included with the other causes of injury to the roots of the sacral plexus.

Lloyd,¹³ however, has contributed an excellent chapter on the subject, and Mills¹⁴ was one of the first to call attention to these cases. Hünemann,¹⁵ from a review of the literature and a study of four cases in the obstetrical clinic at Berlin, determined that the paralysis resulting from trauma during labor nearly always had a definite distribution; *i. e.*, it affected exclusively or most intensely the muscles supplied by the external popliteal nerve. He explains this by the fact that this nerve receives its fibers mostly from the 4th and 5th lumbar roots and that these, after forming the lumbosacral cord, as they pass over the brim of the true pelvis to join the sacral plexus, lie next to the bone and are exposed to pressure, whereas the lower roots of the plexus lie on the pyriform muscle, and are more protected. The injury, he thought, was due to pressure of the head and not to the blade of the forceps.

Hünemann's view has been generally accepted, and but little has been added to the subject since his paper.

The histories of the two cases which I have under treatment are, in brief, as follows:

CASE IV.—J. H. H.—Dis. Nerv., No. 10,159.

Mrs. G., æt. 26. Admitted July 29, 1899. Complains of weakness of right leg following labor.

Family and personal history unimportant. The first confinement was normal. The present trouble she dates from the birth of her second child. She had been well during pregnancy and up to the time of labor, which took place May 10, 1899. The membranes were ruptured at 7 a. m., but as there were no labor pains, she ironed all the morning. The pains began at 1 p. m., but were not very strong. Between 3 and 4 she began to have severe pain in the back of her right leg, between the knee and hip; there were no muscular spasms. The labor not progressing, she was given chloroform at 9 p. m. and the child

¹² See Saeh's excellent article on Prognosis and Treatment (Nervous Diseases of Children, p. 223).

¹³ Twentieth Century Practice of Med. Vol. XI, 1897, p. 307.

¹⁴ University Med. Mag., Vol. V, 1893, p. 508.

¹⁵ Arch. f. Gynækol. Vol. XLII, 1892, p. 489.

was delivered by the aid of forceps. The child died soon after birth.

The patient slept that night but in the morning complained of severe pain through the whole right leg. The leg was paralyzed and felt numb. The pain in the leg persisted, and only gradually improved after she got about. The puerperal period seems to have been perfectly normal except for the pain and weakness in the leg. The patient got up on the 10th day and was able to walk with the aid of a cane. The strength of the leg has improved to some extent, and the pain has slowly passed away. It was never aggravated by the passage of a constipated stool. The leg has always felt numb and cold below the knee.

The records of the patient during July and August, when she was coming every day to the dispensary for electrical treatment, show, in abstract, that there was complete paralysis of the muscles supplied by the right external popliteal nerve, with a certain amount of weakness in the muscles of the calf, and the flexors of the knee on that side. There was typical reaction of degeneration in the distribution of the external popliteal nerve.

The right leg below the knee looked somewhat bluish and felt cold to the observer's hand. The contrast in this respect between the right and left leg was marked. There was a distinct dulling of sensation to touch, temperature and pain over the outer half of the leg below the knee (the cutaneous distribution of the external popliteal nerve). There was no complete anesthesia.

The knee-kicks were active on both sides, the reflex from the tendo Achillis was absent on the right side, but present on the left. Plantar irritation caused a flexor response on both sides.

The patient has come faithfully for treatment and has improved to some extent. The improvement, however, has been in the power of the flexors of the knee and the calf muscles, and now, nearly a year after the injury, these muscles are fairly strong, although they are still weaker than the corresponding muscles of the left leg. There has been no return of power in the external popliteal muscles. The muscles about the hip are all strong.

There is considerable atrophy of the right leg below the knee, the measurements showing that this leg is from 3-4 cm. smaller in circumference than the left. The leg is not so cold as it was, and the dulling of sensation, although still present, is not so marked.

Dr. J. Whitridge Williams was kind enough to make a pelvic examination and he found (April, 1900) that the measurements were practically normal and that there was no evidence of an inflammatory condition anywhere in the pelvis.

CASE V.—J. H. H. Disp. Nerv. No. 10,784. Admitted March 24, 1900. Mrs. C., æt. 25. Complains of weakness and pains in leg following the birth of her child.

Nothing bearing on the present trouble is found in the family or personal history. The child, which was born when the patient was injured, has Duchenne's obstetrical palsy (Case III).

During her pregnancy, which was the first, the patient was well up to the seventh month, at which time she began to have some discomfort, with pains referred to the lower part of the abdomen and the front part of thighs.

The labor began at 4 a. m. on Friday, Feb. 2, 1900. The pains were severe and the physician who examined her at 10 a. m. thought that everything was satisfactory and that the labor would be soon completed. The pains, however, became weaker, and at 6 p. m. it was decided to use instruments. The head was presenting.

Up to this time she had had no pain in her leg. Chloroform was given and she was unconscious for nearly two hours. She has been told that the physician had great difficulty in delivering the child and that the forceps had to be re-applied six or seven times. Upon regaining consciousness she complained of great

pain in her legs below the knees. She was given morphia and slept during the night. The next morning it was noticed that both of her legs were paralyzed; the weakness was at first widespread, but affected the left more than the right. The pain was also severe and persistent and localized in the legs below the knees.

The confinement after the labor was perfectly normal. The patient at no time had any fever.

After three days she began to regain power in her right leg, and this improvement has continued steadily up to the present time, and she now thinks that it is nearly well. The pain which was referred to this leg has grown less and less severe and now she complains only of a numb sensation in the toes. The left leg has also improved to some extent, both in regard to power and the pain which is felt in it.

The pain has always been exaggerated by pressure on the legs and by a passage of a constipated stool. She is often kept awake at night by disagreeable subjective sensations, paresthesia, etc.

The patient got out of bed on the 10th day, but could not walk for three days.

P. C. The patient is a small, delicate-looking woman. Nothing abnormal is noticed about the functions of the cerebral nerves or of the arms and chest.

The patient walks in a remarkable manner. With each step she leans toward the side, so as to bring the center of gravity over the foot that is on the ground, in a manner very suggestive of a case of muscular dystrophy. Combined with this, there is the slapping gait of double foot-drop. The disability is more of the left side.

Movements of hip-joint:

Flexion, strong on both sides.

Extension, somewhat weak, more so on left than right side.

Adduction, fairly strong on both sides.

Abduction, weak, more so on left side.

Rotation out, fairly strong.

Rotation in, perhaps a little weaker.

Movements of knee joint:

Extension, strong on both sides.

Flexion, fairly strong on right side, weak on left.

Movements of ankles:

Extension (plantar flexion) strong on right side, somewhat weaker on left.

Flexion, possible on right side, but these muscles have very little power and are unable to resist any force applied by the examiner to overcome them. No power on left side.

Movement of toes:

Flexion, good on the right side, feeble on left.

Extension, weak on right side, impossible on left.

Electrical examination shows the partial reaction of degeneration in the muscles supplied by the right external popliteal nerve, and the complete reaction of degeneration in the corresponding muscles of the left side. The other muscles show no qualitative changes.

Pressure over the muscles, particularly those on the anterior part of the lower leg, causes pain.

No objective sensory disturbances can be determined, and there is no particular coldness of the leg. There is some swelling over the back of the left foot.

The knee-jerks are active in both legs. The reflex from the tendo Achillis cannot be brought out. Stimulation of the plantar surfaces of the feet causes a flexor response of the toes.

Dr. Williams made a pelvic examination of the patient and sent me the following measurements:

"The patient has a moderately contracted pelvis, the measurements being as follows:

Distance between the anterior sup. spines of the ilium..	22½ em.
Distance between the iliac crests.....	25
Distance between the trochanters	29
Diagonal conjugate	11
True conjugate	9+
Baudalocque's diameter.....	17.5

This is not a very marked degree of contraction, but with a large child may readily explain pressure upon certain nerves of the sacral plexus. The normal measurements are 26, 29, 32, 13 and 21 respectively, and you can readily see that there is a moderate degree of contraction in all diameters of the pelvis."

The patient has been treated with the galvanic current at the dispensary as often as she can come, and she has been directed to apply mild massage to the affected muscles when at home. She has improved considerably; the movements which were noted as weak have all improved in power to some extent. She is now (June, 1900), able to contract voluntarily certain of the muscles supplied by the left anterior popliteal nerve, although with not sufficient power to flex the ankle. Her walk has lost, to a great extent, its wabbling character. She no longer complains of pain.

These two cases are quite analagous and are, I think, good examples of injuries to the roots of the sacral plexus during labor (obstetrical paralysis of the mother).

In both cases the women had passed through a practically normal pregnancy. In both cases the labor was difficult and instruments had to be used. In the first case the pelvis was normal and the child was large; in the second, the pelvis was generally contracted and the child was very large (12½ lbs.).

In the first case there were symptoms that the nerve roots were being compressed (pain in the distribution of the sciatic) before there was any instrumental interference; in the other case there were no such symptoms.

In both cases some pain was complained of directly after the women came from under the influence of anæsthetics and narcotics, and in both the paralysis was noticed at once.

The puerperium appears to have been normal in both cases, the women both getting up on the tenth day.

The paralysis reached its height at once in both women and improved to a certain degree in each case.

In the first case the right leg was alone affected, while in the second case both legs were paralyzed. The paralysis was most marked in the muscles supplied by the external popliteal nerve (the flexors of the ankle and the extensors of the toes); and, indeed, the only absolute paralysis was confined to this distribution. There was, however, a certain amount of weakness in the other muscles supplied by the sciatic nerve. In the second case there was weakness of certain of the movements of the hip joint, particularly abduction (gluteus medius), and to a less degree, extension (gluteus maximus) and inward rotation (gluteus medius), while in the first case no such weakness could be determined.

Electrical changes were demonstrated in the paralyzed muscles in both patients.

Pain was a prominent symptom in both of the cases; this was most intense at first and gradually subsided; it was localized on the outer side of the leg below the knee and on the back of the foot.

Paresthesia and other subjective sensory disturbances were

complained of. An objective dulling of the different sense qualities in the distribution of the cutaneous branch of the external popliteal was determined in the first case; no such disturbance could be found in the other. Vasomotor changes (coldness and blueness of the leg) were marked in the first case but were not noticeably present in the second.

Other than atrophy of the paralyzed muscles, no trophic changes were noticed in either case.

The knee-kicks were active in both cases, but the ankle-jerk could not be obtained on the right side in the first case nor on either side in the second, where both legs were affected. Plantar stimulation caused a flexor response in both women.

In the first case there is, after nearly a year's treatment, a complete paralysis of the flexors of the ankle, while in the second case, when the paralysis was much more wide-spread at first, there is some return of power in all the movements, after sixteen weeks.

These cases correspond closely to those which have been already recorded, but it may be well to refer particularly to one or two points which are somewhat unusual: Pain was a more pronounced symptom in our cases than would be expected from the description that is often given of this type of paralysis. A paralysis of both legs, as in the second case, *is a very unusual occurrence, and I have not seen a description of a similar case*; when it is remembered that, at the same labor, the baby's arm was also paralyzed, the occurrence seems still more remarkable.

In this case the weakness of the glutei, especially the gluteus medius should also be noticed. This gave to the walk its peculiar wabbling character. One would expect that these muscles would be more often paralyzed than the published records indicate, as they receive their nervous supply from the upper part of the sacral plexus.

That the cases which I have described were due to trauma of the roots of the sacral plexus, received during labor, seems to me to require no demonstration. I do not see what other hypothesis can explain the development, distribution and course of the paralysis.

We have not sufficient data to explain why there should have been undue pressure on the nerves in the case of the first woman except that the labor was difficult and protracted. Her pelvis is of normal size and shape. There was probably some abnormality in regard to the presentation, which if it had been recognized might have explained the injury.

In the second woman the conditions were just those that Hünermann believed to be most favorable for the production of these paralyses; *i. e.*, a generally contracted pelvis and a large child. That the nerves were injured on both sides of the pelvis, may have been due to the fact that the forceps were reapplied several times and to the possibility that during these procedures the position of the head was altered and pressure was made first on one side and afterwards on the other.

In explaining the distribution of the paralysis, authors have generally accepted Hünermann's theory, that the injury is particularly to the lumbosacral cord on account of its ex-

posed position, and that from this cord the external popliteal nerve receives most of its nerve fibers.

But here again the conditions are not so simple as this would indicate. It is true that the lumbosacral cord does occupy an exposed position as it lies next the bone on the innominate line, and protected from pressure only by the blood-vessels which lie over it. This cord, however, sends fibers to the internal as well as to the external popliteal, and the latter nerve receives fibers from the first and second sacral roots, as well as from the lumbosacral cord. Dr. C. R. Bardeen, Associate in Anatomy Johns Hopkins University, has tabulated the actual condition found in about 200 dissections of the sacral plexus, made in the Anatomical Laboratory. Through the courtesy of Dr. Bardeen I am able to give some of his results in advance of their detailed publication. He finds it not unusual to have the external and internal popliteal nerves entirely separated up to their origin from the plexus (in about 10 per cent), and that in all cases it is easy to separate them with very little injury.

The common formation of the external popliteal nerve is from the fourth and fifth lumbar and the first and second sacral nerves (60.5 per cent). The common formation of the internal popliteal nerve is from the fourth and fifth lumbar and the first three sacral nerves (64.5 per cent). The following table illustrates in concise form the results found in 127 plexuses.

TABLE SHOWING THE GROUPS OF SPINAL NERVES WHICH CONTRIBUTED TO THE TIBIAL AND PERONEAL NERVES IN 127 INSTANCES.

Group of spinal nerves contributing.	Peroneal nerve.		Tibial nerve.	
	No. of inst.	Per cent.	No. of inst.	Per cent.
23d-26th (3l-1s)	1	.8		
23d-27th (3l-2s)	3	2.4		
24th-25th (4l-5l)	1	.8		
24th-26th (4l-1s)	30	23.6	1	.8
24th-27th (4l-2s)	77	60.5	18	14.2
24th-28th (4l-3s)	3	2.4	2	64.5
24th-29th (4l-4s)			10	7.9
25th-27th (5l-2s)	9	7.		
25th-28th (5l-3s)	3	2.4	1	7.9
25th-29th (5l-4s)			6	4.7
	127	99.9	127	100.0

In this table it will be noted that there is found at times a considerable variation from the normal origin of the peroneal and tibial nerves. In some instances a group of nerves more anteriorly situated, in some a group of nerves more posteriorly situated than normal, contributes to their formation. When a more anterior or a more posterior group of nerves than the normal contributes to the external and internal popliteal nerves, there is usually found at the same time an alteration in the relative position of the pelvis, so that the roots of the limb nerves have relations to the pelvis approximately similar to that which they have in normal conditions.

In most instances the peroneal nerve receives the bulk of its fibers from the fifth lumbar and first sacral nerves, and the tibial the bulk of its fibers from the first and second sacral nerves.

If one consults Wichmann's¹⁰ monograph, it will be seen what a great number of muscles he finds represented in each of the roots that form the sacral plexus: 32 in the 4th lumbar, 33 in the 5th, 42 in the 1st sacral, etc., etc., each muscle being represented in from two to four roots.

All that can be said is that, on the whole, the muscles supplied by the external popliteal nerve are represented higher in the plexus than those supplied by the internal popliteal (lumbar IV-V, sacral I for the first and lumbar V to sacral I and II for the second).

It is not easy to understand how an injury to the lumbosacral cord (*i. e.* the fourth and fifth lumbar roots), could cause a motor and sensory paralysis so sharply limited to the distribution of the external popliteal nerve, as often occurs in obstetrical paralyzes (our first case).

Dr. Bardeen has suggested as a possible explanation the fact that the branches of the roots that go to form the external popliteal nerve are given off from the dorsal aspect of the plexus¹¹ and lie next to the bone, while those forming the internal popliteal lie on them, and that, therefore, these dorsal offsets would be apt to be injured.

With this addition to Hünemann's theory we might state the explanation as follows: *The upper roots of the sacral plexus do not lie upon the pyriform muscle, but against the bony wall of the pelvis, and are thus exposed to injury from pressure during certain difficult labors. It is the dorsal offsets of these roots which lie against the bone and which receive the chief injury. The external popliteal nerve is made up from these dorsal offsets, and therefore the paralysis is chiefly localized in the distribution of this nerve.*

The superior gluteal nerve supplying the gluteus medius and minimus muscles and the inferior gluteal nerve supplying the gluteus maximus also receive their nerve fibers from the dorsal division of the roots of the plexus, and it is interesting to note that these muscles are not infrequently paralyzed in obstetrical paralysis. Our second case is an example of this.

Although it seems clear to me that these cases are due to trauma of the nerve-roots during labor, the view has not been universally accepted. Lloyd¹² considers the question fully and concludes as follows:

"From the facts and authorities already cited, it is evident that there is some latitude for differences of opinion as to the exact causation of lesions of the sacral plexus and its chief trunks during labor. The older writers were evidently disposed to regard pressure by the head and injuries by the forceps in prolonged and difficult labor as important factors in causing these paralyzes. The tendency of more modern writers is to dissent from this view, and to ascribe lesions of the sacral plexus and its branches to a septic inflammation, propagated directly to the nerve trunks from a metritis or a periuterine cellulitis. I do not see that it is necessary to ignore either one or other of these important factors, although I believe that the theory of septic infection is one that more satisfactorily explains the

¹⁰ Die Rückenmarksnerven und ihre Segmentbezüge, Berlin, 1900.
¹¹ See the excellent figure in Quain's Anatomy, Vol. III, pt. II, 1895, p. 324.
¹² Op. cit., p. 313.

majority of these cases. There can be little doubt, however, that in case of a large head or a contracted pelvis, the instruments, especially if applied in a faulty manner, might make pressure upon the sacral plexus where it lies upon the body of the pyriform muscle, or especially upon the trunk of the sciatic nerve where it emerges below the lower margin of that muscle, and where, by reason of its great size and its exposed position, it is liable to injury."

That the nerves may be involved in inflammatory conditions of the pelvis to such an extent as to cause paralysis is very generally stated upon good authority, but personally I have had no experience with such cases. They must be unusual for I have been unable to find the record of such a case in Dr. Howard A. Kelly's very active gynecological service. No such case has been referred to the neurological department for examination, and neither Dr. Kelly nor any of his associates can remember such a case. It may also be added that we have not seen a paralysis due to the involvement of the nerves during the growth of a pelvic tumor, which seems remarkable when one reads the statements in textbooks.

A good deal of the confusion is due to the habit of classing together all cases of paralysis which develop during the puerperal state under such general names as "puerperal paralysis" or "puerperal neuritis." This is manifestly a mistake as there are several conditions occurring during labor and confinement which cause paralysis.

Windscheit,¹⁹ under the title "Neuritis gravidarum und Neuritis puerperalis," gives a very interesting summary of the different conditions which may be classed under the term neuritis. He divides puerperal neuritis into four classes:

1. Certain cases which had developed during pregnancy (neuritis gravidarum) and have persisted after confinement. The etiology of these rare cases is not known, but they are supposed to be due to the action of some poison circulating in the blood. The clinical picture is usually that of the pure motor form of neuritis. No especial nerves are liable to be affected. There is a gradual weakness of the different nerves of the extremities; the muscles atrophy and show the reaction of degeneration; trophic changes occur. The nerve trunks are sensitive to pressure. Slight sensory changes may be present. Pain is not frequently complained of.

2. Neuritis due to puerperal infection. Here the neuritis is purely local, due to the extension of the inflammatory exudates, so as to involve the pelvic nerve. Such cases have been recognized for a long time. He refers to von Leyden²⁰ but gives no other references. Under this head he also classes those cases following general pyemia, in which all the nerves of the body may be affected and not alone those of the lower extremities.

3. Puerperal neuritis due to traumatic injury during labor. To this group the cases which I have described belong. Windscheit has no doubt as to their cause, for he says "Es handelt sich hier um rein mechanische Momente."

4. Puerperal neuritis (Moebius). Under this head are grouped those peculiar cases first described by Moebius²¹ and afterwards by other observers, especially Eulenberg.²² These cases develop in women in whom pregnancy and confinement have been perfectly normal, and in whom there have been no other diseases from which the neuritis could have developed. Two forms are distinguished (Eulenberg):

(a) The localized form. In this form only one or two nerves are affected. In the arm the median and the ulnar—the arm type. In the leg the crural—the leg type. Other nerves have also been found diseased, even the optic nerve. In these nerves there develops very soon after an entirely normal confinement, a paralysis with atrophy of the muscles and the reaction of degeneration. There is seldom any pain or objective sensory disturbance. The prognosis is not entirely good. Recovery may take place, but there have been more cases described in which this did not occur.

(b) The generalized form. In this the paralysis develops in many nerves at the same time, and often after the manner of Landry's paralysis; *i. e.*, the ascending type. The cranial nerves have also been described as affected. In these cases the prognosis is still graver than in the localized form, and death has occurred from the involvement of the respiratory nerves.

The cause of these cases is not known. Here again, as in the neuritis of pregnancy, some unknown toxic agent has been blamed. It has also been thought that the anemia following hemorrhage may have been the cause. Strong antiseptic douches have also been blamed.

It would seem to me to add clearness if the name puerperal neuritis were used to designate those cases classed in the fourth group. These cases are peculiar to the puerperal state, and as yet we know of no cause for them other than certain indefinite abnormalities dependent upon this state. It is probable that in this group there are cases belonging to different categories and that future examination will distinguish them. At present this does not seem possible, and they may well be classed together under the term "puerperal neuritis."

In regard to the other three groups, we have only to consider the second and third, for there is no reason to distinguish the first group from cases occurring in pregnancy (neuritis of pregnancy).

In the second group are the septic cases which seem only peculiar to the puerperal state in the time of the infection. The name *septic neuritis* (puerperal), with the qualifying subtitles, (a) local; (b) general, would seem to distinguish these cases.

In the remaining group, the third, are those cases which are believed to be due simply to trauma of the pelvic nerves during labor. This group might be named *traumatic puerperal neuritis*, if one classed every paralysis due to traumatic injury of nerves as a neuritis. This is not usually done, and the distinction between traumatic paralysis and traumatic neuritis is largely a matter of individual choice. It would.

¹⁹ Sammlung Zwanglosen Abhandlungen aus dem Gebiete der Frauenheilkunde u. Geburtshilfe, v. Max Graefe, Bd. II, 1899.

²⁰ Charité Annalen, 1862.

²¹ Münchener med. Wochenschrift, 1887, No. 9.

²² Deutsch. med. Wochenschrift, 1895, Nr. 8 u. 9.

however, seem wise to distinguish these cases by a name that calls particular attention to the manner of their production. Duchenne called the paralysis of the baby's arm due to injuries of the nerve received during birth, *infantile obstetrical palsy*, or birth palsy. I would suggest that cases of paralysis occurring in women due to injury during labor be also called *obstetrical paralysis*, and that the adjectives *infantile* and *maternal* be used to distinguish the two conditions: Thus *infantile obstetrical paralysis* (Duchenne), or obstetrical paralysis of the infant; and *maternal obstetrical paralysis*, or obstetrical paralysis of the mother.

In this way emphasis is laid on the causes of these conditions, which being borne in mind, measures are more apt to be taken to prevent trauma during labor.

Schoemaker²³ tried to show how obstetricians should guard against injury of the brachial plexus of the child, and Huber²⁴ explains how he believes the nerves of the mother can best be protected.

This is an obstetrical question the full discussion of which would be out of place at the present time by the speaker. I shall endeavor, however, to summarize in a few sentences Huber's chief conclusions.

He believes that the birth itself is responsible for most cases of puerperal neuritis (a name which he uses in a very general sense), and that the physician should be on his guard against dangers occurring at this time. The chief danger is the undue pressure of the child's head on the nerves of the pelvis, which is more apt to occur the greater the disproportion between the size of the head and that of the mother's pelvis, and the longer the pressure is continued. He therefore says that the labor should not be allowed to continue longer than is absolutely necessary; that, if it halts, instruments should be used if the soft parts are sufficiently dilated. He is careful to state that this interference should be undertaken only under the strictest obstetrical rules; for, if these be disregarded, more harm may be done than if no interference were made. Badly applied forceps may themselves injure the nerves. He advises the early administration of chloroform to relax the muscles of the pelvis and to increase the available space. He has never seen any harm come from its administration but only good. He cautions against the too zealous employment of hydrotherapeutic measures directly after labor, and he thinks, for instance, that a cold sitz-bath at this time may cause an inflammatory condition of the nerves.

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OXYGEN AND STEAM WITH THE VAPORS OF A SPECIAL INHALATION MIXTURE IN PULMONARY DISEASES.¹

BY CLEMENT A. PENROSE, M. D.

At a former meeting of this Society I read a paper entitled "Infusion of Salt Solution combined with a special method of administering oxygen in pneumonia." This method consisted in passing the oxygen through a wash bottle containing one pint of boiling water in which had been placed one dram of a mixture of creosote, oil of turpentine and compound tincture of benzoinum. In place of the old delivery nozzle, a special funnel was used. The cases reported in that article, with others more recent, proved quite definitely the following: First, oxygen being heated and mixed with steam was more readily absorbed, less drying to throat and tongue, and more agreeable to the patient. Second, passed through a heated inhalation mixture like the above, it certainly had a marked antiseptic effect on the mouth and tongue, evidenced by sweetness of the breath and improved appearance of these parts, no matter how foul at the start. Might it not also have an antiseptic action on the lungs? Third, the pleasant odor of the inhalation mixture gave something tangible for the patients to breathe, who therefore made greater efforts to inhale the oxygen and keep the face under the funnel. This was especially true in children or semi-conscious patients.

Being much impressed by the benefits derived from inhalations of this character in pneumonia, it was decided to give the method a thorough trial in other pulmonary diseases, and this was done with remarkable success in a number of cases. In some of these oxygen being too expensive, compressed air was used, or simply steam alone, while in others I would give the oxygen at my office and have the patients use air or steam at home. The majority were treated in this manner. A few cases, and notably one case of tuberculosis, was treated with oxygen alone, the patient keeping cylinders of this gas at his home. The results in simple acute coryzas and various catarrhal affections of the pharynx and naso-pharynx, grip, acute and chronic bronchitis, etc., were really astonishing.

In a number of cases, purposely, no internal medication was employed, even in quite severe cases of grip, and yet results, when used early, were often about as good as when it was. Several inhalations, sometimes even one, occasionally being sufficient to bring the condition to a termination. I recommend for home use, where a cylinder of oxygen could not be afforded, the "Benzoin Inhaler" or the "Hynson and Westcott Inhaler," a better modification. This is simply a tin can with an arm and mouthpiece into which one pint of boiling water can be poured. One teaspoonful of the inhalation mixture is then dropped in, the lid clapped on, and the patient breathes in the fumes as they arise from the hot water.

A number of families in this city are never without this little inhaler, which is utilized at the onset of the slightest

cold. From a number of cases, three have been selected, with the hope that they might be of interest to the Society, not only from the fact that they were hard cases to benefit, or represented pulmonary conditions of the worst type, but also because they were treated by the inhalation method in different ways, viz:

1st Case. Inhalation mixture and steam alone.

2nd Case. Inhalation mixture, steam and oxygen.

3rd Case. Combined method, inhalation mixture and steam at home; inhalation mixture, steam and oxygen at office.

CASE 1.—August 16, 1899. F. M., a barber, aged twenty-two, with chronic purulent bronchitis of several years' standing in spite of various treatments. On examination, this patient showed considerable emaciation, had a hacking cough, with much mucopurulent expectoration, containing numbers of pus and other organisms. The chest, which was long and narrow with limited expansion, contained numerous medium-sized moist râles and some piping and sibilant râles.

Treatment.—Simple iron tonic, inhalations three times a day of the inhalation mixture from a Benzoin Inhaler, respiratory calisthenics and general gymnastic work. Result: rapid disappearance of sputum and organisms therein. In three months the patient was practically well. He has gone through a very changeable and trying winter without a cold, something which was never done before while suffering from his bronchial affection. At the time this was written, the patient has gained about ten pounds, and feels and looks like a different man.

CASE 2.—October 30, 1899. Mr. B. L., merchant, aged 59, with pulmonary tuberculosis. This patient gave a history of a chronic bronchitis of about twelve years' duration, with more acute symptoms the last year. On examination he was fairly well nourished, but pale and ill-looking. The chest was well shaped, but with limited expansion. There was decided flatness over the right infrascapular region, in which a number of gurgling, sibilant liquid râles were heard. These râles were also present at the apex and front. Down in the left subscapular region and around in the axilla a considerable number of dry crepitant râles were found. The patient had a hacking cough, especially in the morning, after which he raised a considerable amount of greenish-yellow purulent sputum. This contained numbers of pus organisms and a considerable number of tubercle bacilli. At time of first visit his temperature was only slightly febrile, but it had been much higher. The case was evidently one of tubercular consolidation in the upper right lobe just beginning to soften and break down.

Treatment.—Inhalations twice a day of oxygen passed

¹ Read before the Medical Society of The Johns Hopkins Hospital, Feb. 5, 1900.

through the steam inhalation, with regular breathing exercises and calisthenics. Creosote was given internally in two-minim doses and cod-liver oil. I will omit a detailed description of the improvement in this case, which was most striking from the very onset. The sputum rapidly grew less in amount, with disappearance of the pus organisms. The patient began to gain weight and noticed especially his increased energy. On February 5, after three months of treatment, the tubercle bacilli had entirely disappeared from the sputum, which was very scant. The gain in weight was over seven pounds, and the patient said he had not felt as well for years. An examination of the chest showed no râles, and but for slight evidences of consolidation was negative. The softening process had evidently ceased, and that of repair seemed to have succeeded. Since this time the patient has continued to improve, and now weighs 163 pounds, a gain of about 12 pounds since treatment was begun. He has had only one cold during the winter, which was readily thrown off, a most unusual event for him.

CASE 3.—The last case to be reported is one of great interest to me, representing, as it does, a rare pulmonary disorder, chronic infantile putrid bronchitis, and also because the little patient came all the way from Havana, Cuba, especially for this treatment. Her father, a man of considerable means, had spared nothing in his efforts to have his daughter cured, and had taken her on different occasions to the mountains of Cuba and Mexico, and also to this country (New York), for medical advice and treatment. The patient, Miss G. R., now aged thirteen, has kindly consented to be presented to the Society, and it can be seen at once she does not look much like an invalid. When one and a half years old an attack of severe bronchitis was followed by a gradual dilatation of the smaller bronchi of the lungs, a condition which was recognized by Dr. Pirez Miro, of Cuba. As the child grew up, this dilated condition of the bronchi became somewhat less marked, but was aggravated by an attack of pneumonia a few years later. She was never without a cough, suffered from severe asthma-like attacks at night, coughed up large amounts of very offensive sputum, with occasional yellow or blackish balls; *i. e.*, probably Dittrich's plugs. The child developed very slowly, had an almost continual fever, and for months at a time her life was despaired of. The mountain air in this case seemed to aggravate rather than relieve the conditions. In fact, while in the mountains of Mexico, she had the attack of pneumonia mentioned above, and could barely be moved home. When I first saw the case, June 3, 1899, examination showed a very small, thin girl, quiet and subdued in manner, weight only 54 pounds, with a cold, clammy skin, temperature 101° to 103° , tongue coated and breath very offensive. She had a continual hacking cough, with expectoration of much mucopurulent sputum of a greenish-yellow color, with considerable amount of frothy, lighter colored material. This sputum contained almost every kind of organism except the tubercle bacilli. There were chains of streptococci and bacilli, with abundant pus. The chest was narrow, ribs and clavicles very promi-

nent. Expansion limited throughout. The note on percussion rather hyperresonant over both lungs. On auscultation the chest was a virtual music-box. Sibilant, piping râles, harsh mucous râles, amphoric sounds, etc., were heard everywhere.

Treatment.—The treatment in this case consisted of inhalations of steam and inhalation mixture three times a day at home. Oxygen, steam and inhalation mixture two to three times a week at my office. Later, when the fever was less, breathing exercises and calisthenics were employed. Purposely no cod-liver oil or expectorants were used, as they had been tried so thoroughly in Cuba, and the only medicine taken was pepto-manganate of iron three times a day with alcohol sponges at night. The result, a rapid improvement, in a few weeks; cough and expectoration was much less, and almost free from bacteria; the breath was sweet and tongue clean; temperature slightly febrile; about three to four pounds gain in weight. In five months' time patient had *no expectoration*, and *weighed 82 pounds, a gain of 28 pounds*; she could run and play with other children and showed rapid development in every way. The fever had entirely disappeared. At the present time she weighs 87 pounds, and but for an occasional cough, more from habit and increased when excited, she is absolutely well. The chest, with the exception of a few dry, crepitant râles, due in great part to thickening of the pleura, is clear and shows an increase in girth of four inches, with a much greater degree of expansion. I have now begun to use cod-liver oil and creosote internally to see whether any additional benefit can be obtained. Since this was written the patient has had a severe attack of measles—which is generally so disastrous to those with any bronchial affection—without having in the least lost ground.

CONCLUSION.

The great quantity and variety of medicines taken internally for acute coryzas, bronchitis, grip, are appalling to the conscientious physician. In addition, numbers of compound remedies with very elaborate titles are daily prescribed for these conditions, some of the ingredients of which, or at least their dosage, too often escaping the memories of those using them. Inhalation methods are the rational means for combating pulmonary affections. Internal medication should be used as an accessory treatment, as for instance, a sedative mixture to relieve excessive coughing, etc. I do not consider diet in this category. Change of climate, mountain air, etc.—in reality inhalation treatments—are all very well for those who can afford them, but what can be done for the masses to whom this is an impossibility? Because many have found inhalations of various kinds of little value in tuberculosis, there is yet no reason to suppose the best treatment will not be found along these lines. I regret that only one case is at hand to demonstrate the utility of this method in that disease. The good effects of oxygen in pulmonary disorders are raised to a maximum when combined with the heated vapors of my inhalation mixture. This mixture has never yet proved irritating or dangerous to the healthy lungs, although possessing

such marked antiseptic properties. At the start a formula: Creosote (Beechwood), Olei Terebinthinæ ā ā drams IV, Tr. Benzoini Co., oz. III, is used (one dram of this mixture being placed in a pint of hot water). As the patient becomes more accustomed to the fumes, *i. e.* does not cough or choke during inhalation, gradually more of the creosote and oil of turpentine is added till a mixture of equal parts of each is obtained: Creosote (Beechwood), Olei Terebinthinæ, Tr. Benzoini Co., ā ā, oz. I.

Inhalations to be effective should be systematic and of sufficient duration, ten to fifteen minutes at least. An indispensable adjunct are breathing exercises and general gymnastic work. No physician can hope to have success in pulmonary diseases unless he makes a thorough study of chest development, calisthenics, and other forms of exercise. In fact, it is necessary that he have a love for this kind of work himself, and by personal example try to awaken in his patients—who, as a rule, are phlegmatic or indifferent—the enthusiasm so important in this kind of work. The excellent work by Dr. Dennison, of Denver, entitled “Exercise and Food in Pulmonary Disorders” has demonstrated the great advantages of such exercises.

The bacteriological examination made of the sputum in a number of my cases proves the marked antiseptic effect of the above inhalation mixtures, especially on the pus cocci. Now,

even if, as many authorities have shown, tubercle bacilli, being walled off, are protected from all inhalation vapors, when the severe symptoms so often due to secondary infection are eliminated and other portions of the lungs exercised and disinfected, beyond question a better chance is given to resist the spread of the morbid condition and to wall off completely the tuberculous area.

In addition, some persons will use an inhalation who could never be induced to take breathing exercises. The act of inhaling is, however, a very efficient exercise as any one can easily prove.

Inhalations rarely upset the stomach like cough syrups, etc., and eliminate much of the fatiguing routine of hourly medication. Children will inhale—smoke, as they often call it—willingly if a little diplomacy is used, where they often require force and much coaxing to take medicine.

The science of medicine has advanced beyond the point where we look to it merely for cures. The twentieth century brings with it more appeals than ever for instruction in the prevention of diseases, and especially of those of the respiratory apparatus. If we teach the tailor how to avoid a crooked back, the factory girl how to expand her lungs and utilize what fresh air she occasionally gets; if we place in the hand of the masses a simple method of avoiding colds, etc., we will find our clinics smaller, but our humanity larger.

OBITUARY: JESSE WILLIAM LAZEAR.¹

MR. PRESIDENT AND GENTLEMEN:

Before we proceed with the programme this evening, I should like to say a few words about our dear friend Lazear, whose sad death at Quemados, Cuba, on September 25, is so fresh in our minds. Lazear was born just outside of Baltimore thirty-four years ago. He graduated at the Academic Department of the Johns Hopkins University in 1889, and three years later obtained the degree of M. D. from Columbia University, New York. After this he was an interne in the Bellevue Hospital for two years. After spending the greater part of the year in studying abroad, particularly in Paris, he returned in 1895 and became one of the medical staff of the Johns Hopkins Hospital. In the summer of 1896, Dr. Lazear was married and began the practice of medicine in Baltimore. At the same time, however, he was an assistant in clinical microscopy in the University, and in the laryngological department in the Hospital dispensary. Last winter he obtained an appointment as assistant surgeon in the army with special laboratory duties, and was stationed in Havana. There he soon became interested in the study of yellow fever, and for several months he had been one of the commission appointed by the Surgeon-General, for the study of this dis-

ease. He had been constantly exposed to infection, and finally, in the course of his duty, contracted his fatal illness.

Dr. Lazear was a man of few words but keen perception. He was an extremely careful and thorough worker. He kept his own counsel, asked few questions and little help of his associates, but he was a man who, when he started an undertaking, had the ability and enthusiasm to keep quietly at work until he accomplished his end. It was through his excellent work that we were able several years ago to make our first positive *intra vitam* diagnosis of septicæmia due to the diplococcus of Neisser. His valuable studies upon the internal structure of the malarial parasite, which I had the pleasure of bringing before this society last winter, are remembered by all.

Personally, he was an exceptionally simple, high-minded and lovable man. He could not have failed to find in a short time a public position in which his unusual merits would have become more generally known.

I should like to suggest to the Society the adoption of the following resolutions:

“Whereas, On the 26th day of September, our beloved colleague and friend, Jesse William Lazear, lost his life in the discharge of his duty as a member of the United States Yellow Fever Commission;

“And whereas, His exceptional ability in his profession, his

¹ Remarks made by Dr. W. S. Thayer, at the meeting of The Johns Hopkins Hospital Medical Society, Oct. 16, 1900.

simplicity and modesty as a man, had greatly endeared him to all whose good fortune it was to know him;

"*Be it resolved*, That we, his former colleagues and associates, do hereby express our profound sorrow at the loss, to the community of one whose future was unusually rich in promise, to ourselves, of a dear friend and fellow student;

"*And be it further resolved*, That we express to his wife and family our warmest and most heartfelt sympathy."

The resolutions were unanimously adopted.

NOTES ON NEW BOOKS.

Diseases of the Nose and Throat. By J. PRICE BROWN, M. B., L. R., C. P. E., Member of the College of Physicians, Ontario, etc. Illustrated with 159 engravings, including 6 full-page color plates and 9 color cuts in the text, many of them original. (Philadelphia, New York, Chicago: The F. A. Davis Company, Publishers, 1900.)

This volume, although rather too condensed for the specialist, can be heartily endorsed as a guide to the general practitioner in the diagnosis and treatment of such laryngological and rhinological cases as may come under his observation.

One is particularly impressed with its readability, the style being extremely fluent. The treatment, especially of the more prevalent conditions, is taken up in a simple and logical manner, which is easy to comprehend.

The chapter on examination is especially to be commended; and it is interesting to note that the author devotes considerable space (Chapter 63) to the description of Autoscopy, introduced by A. Kirstein, of Berlin, and brought forward in this country by Max Thorner, of Cincinnati, and discusses (Chapter 83) the uses of the Roentgen ray in laryngeal surgery.

General practitioners are in great need of books written especially for them by competent specialists. Doctor Price Brown's book will meet this demand in laryngology most satisfactorily.

C. A. PENROSE.

A Text-Book of Diseases of the Nose and Throat. By D. BRADEN KYLE, M. D., Clinical Professor of Laryngology and Rhinology, Jefferson Medical College, etc. With 175 illustrations, 23 of them in colors. (Philadelphia: W. B. Saunders, 925 Walnut Street, 1899.)

This book of 650 pages presents many points of interest. The classification of the various conditions from a pathological standpoint is very satisfactory, although there is much need of further work in the pathology of diseases of the nose and throat. The illustrations are, for the most part, original and appropriate. The details of treatment are fully entered into and are up to date.

In Chapter III, the use of the term catarrh is very properly deplored as indicating any definite disease. It is indeed better to use the adjective catarrhal in connection with special forms of inflammation.

In Chapter VIII, the nasal neuroses are thoroughly discussed with special reference to their etiology. Considerable weight is given to the effects of the pollen of plants as the exciting agent in many cases of hay fever. The author believes the term Hyperesthetic Rhinitis to be the most appropriate one for this condition.

The various neoplasms of the respiratory tract are taken up (Chapter XI) in great detail with especial reference to their

pathology and are carefully classified. In Chapter XXIII, the advantage of a preliminary tracheotomy in most operations on the larynx is denied, and a very suggestive method outlined for a complete laryngectomy with the patient in the "Trendelenburg" position, which is maintained for three days after the operation.

In order to attain completeness and to render reference less arduous, as stated in the preface, considerable repetition has been necessary, but this is by no means a fault, and adds much to the clearness of the book.

The author has unquestionably given to the medical profession a work of great merit—the result of much labor and careful thought, and one which will be of great service to every one desiring to be proficient in this specialty.

C. A. PENROSE.

The Pathology and Surgical Treatment of Tumors. By N. SENN, M. D., Ph. D., LL. D. Second Edition, revised. Illustrated by 478 engravings and 12 full-page plates in colors. (Philadelphia: W. B. Saunders, 1900.)

This new edition of a valuable work is welcomed by all who knew the worth of the former. The book is useful to both surgeon and pathologist, dealing thoroughly and conscientiously with all forms of tumors and presenting recent facts concerning them. The arrangement of material is practical, and insures an interesting recapitulation of the most important details of each subject considered.

The first twelve chapters, dealing with the origin, etiology, biology, pathology, clinical aspects, diagnosis, prognosis, treatment and classification of tumors, are the most interesting. They present a full scientific and practical review of much of the best and most interesting material which falls to the pathologist to study.

A short chapter on tumors in plants and animals, with references to the work on the parasitic origin of tumors, makes a very interesting *résumé* of our knowledge in this most actively worked field. Senn classifies tumors according to the embryonic tissue in which they develop, and adds a chapter on retention cysts, or swellings caused by the retention of physiological secretions. These cysts, he claims, cannot well be differentiated from tumors.

Senn properly states that we have not approached any nearer the solution of the question of the causation of tumors than the older masters. One expression repeated often in his book cannot be too deeply impressed on a student's mind, namely, that the tumor arises from a matrix of embryonic cells misplaced either in embryonic or in the post-natal life. In discussing the influence of the surrounding tissues on tumor growth, he ascribes to them a negative influence. There is, however, a growing tendency to assign a more active part to the tissues in which the tumor grows. Senn rejects the theory of the microbic origin of tumors. He would place them among the granulomata, if an infective cause were proven.

In describing special tumors, he gives their counterparts in the normal tissues of the body, and treats of them systematically under the following headings: Description, Histology and Pathology, Etiology, Transformations, Topography, Diagnosis, Prognosis, and Treatment. His chapter on Diagnosis is clearly and thoroughly written from the pathological and clinical standpoint, and most systematically arranged. It is of interest to note that he considers the microscope overrated as an aid to diagnosis.

Conservative and radical measures for the treatment of tumors are equally described; and where a radical operation is advised, it is described in detail.

The volume is well illustrated and printed, and is an authority in the medical world.

Essentials of Diagnosis; arranged in the form of Questions and Answers. Prepared especially for Students of Medicine. By SOLOMON SOLIS-COHEN, M. D., and AUGUSTUS A. ESHNER, M. D. Illustrated. Second Edition, revised and enlarged. (*Philadelphia: W. B. Saunders, 1900.*)

This second edition of a deservedly popular hand-book of medical diagnosis has been thoroughly revised and considerably enlarged. The definitions are sometimes too much compressed to be clear, and the book generally may be said to suffer from an attempt to compress it into a narrow space. It contains an occasional personal observation, but for the most part the book is a compilation from other text-books. The work is methodically and painstakingly done, and the authors deserve much praise for their labor. It can but assist those persons who wish to renew their acquaintance with the science of medicine.

University of Pennsylvania. Contributions from the William Pepper Laboratory of Clinical Medicine. (*Philadelphia: Published on the Phæbe A. Hearst Foundation, 1900.*)

This volume of 479 pages contains thirteen original contributions to medical literature, the result of recent investigations conducted in the William Pepper Laboratory of Clinical Medicine. It is published in memory of the late Dr. William Pepper, through whose generosity the laboratory was founded.

There is an excellent photogravure of Dr. William Pepper. The style of the volume is pleasing to the eye. The paper and printing are excellent. The colored plates and the cuts in the text are fairly good.

It is impossible to attempt a digest of the various articles in a review of this kind, and while it would be an injustice to particularize, we think that some of the contributions deserve special mention. Dr. William Spiller reports two cases of muscular dystrophy with the gross and microscopic findings at autopsy. In another contribution he reports a case of amyotrophic lateral sclerosis in which degeneration was traced from the cerebral cortex to the muscles. The most elaborate report is by Dr. Alonzo E. Taylor. It comprises 180 pages, and in it he gives the result of his "Studies in Leukæmia," which are based on the study of sixteen cases. We had hoped to find some mention of Löwits's parasitic theory of the causation of both lymphatic and myelogenous leukæmia. We regret that Dr. Taylor has not studied the blood from this standpoint, because Löwits's views have yet to be confirmed, and they have recently been severely attacked by Türk, of Vienna. Dr. Stengel has an interesting contribution on the pathology of the erythrocyte. The other papers, although shorter, are fully as deserving of mention. There is also a list of the previous contributions from the laboratory.

The volume does full justice to the object it was intended to serve, and we take great pleasure in congratulating Dr. Stengel, the director of the laboratory. If we were to offer any criticism, we would point to the rather large number of papers in this volume and in the list of previous contributions which deal with the pathological side of medicine and which would seem more in place in the reports from a pathological laboratory than from a laboratory of clinical medicine.

Surgical Anæsthesia, Addresses and Other Papers. By HENRY JACOB BIGELOW, A. M., M. D., LL. D. (*Boston: Little, Brown & Company.*)

The first part of this volume of 378 pages contains a series of papers, arranged in chronological order, dealing with the discovery of surgical anæsthesia. The majority of the papers have been published in various medical journals, particularly the Boston Medical and Surgical Journal, but a few appear here for the first time. Those interested in the question of the priority of

the discovery of anæsthesia will find these papers particularly instructive, and the medical profession generally will find them entertaining reading.

The papers were written between the years 1846 and 1876. Throughout, Dr. Bigelow is an ardent supporter of Dr. Morton, whom he considers the discoverer of ether anæsthesia. Dr. Bigelow was a contemporary of Dr. Morton and was perfectly familiar with the facts concerning the discovery from the first. It was Dr. Bigelow who first publicly announced Morton's great discovery. The first time ether was used to relieve sensibility to pain in a surgical operation was on October 16, 1846. The anæsthetic was given by Dr. Morton and the operation was performed by Dr. Warren. Morton had previously used the drug in his dental practice in the extraction of teeth.

Dr. Bigelow strongly defends Morton against all others who attempted to claim priority in the use of ether as an anæsthetic, as well as against those who at first endeavored to belittle the importance of the discovery. Apparently Dr. Bigelow was not familiar with the claims of Dr. Crawford W. Long, of Jefferson, Georgia, to priority in the discovery of the anæsthetic effects of ether, as his name does not appear anywhere in the controversy. Many claim that to Long belongs the credit of the discovery. Long operated on his first case under ether on March 30, 1842, practically four and a half years previous to Morton and Warren's first case, and there are records of his having operated on eight cases previous to the date of Warren's operation. Unfortunately for Long, he did not publish his cases until after 1846. Dr. Bigelow would probably have answered Long's contention as he did that of others as follows:

"Many may have been the real discoverers of ether insensibility to pain, and at a remote period. But if so, they have kept it to themselves; and they will be known as discoverers only to themselves. The world has always honored that individual among such discoverers who presented his discovery to them. Dr. Morton was, according to the evidence in print, both the prime mover and the immediate agent in the introduction of this discovery to the world."

There is considerable repetition in these articles on anæsthesia, but the fact that they were contributed at various intervals during three decades merely serves to impress us with Dr. Bigelow's great readiness, as occasion arose, to do honor to Morton and his great discovery.

The second part of the volume contains a number of interesting addresses on general medical subjects. The most important of these are: "Fragments of Medical Science and Art"; "Science and Success"; "Medical Education in America." These impress one with Dr. Bigelow's clear style of writing and with his wonderful fund of general information. In the latter address, written in 1871, he comes out rather strongly on the side of the antivivisectionists, particularly against vivisection which occasions any degree of pain to the animals experimented upon. His views are further given in two heretofore unpublished letters on the question of vivisection.

Medical and Surgical Report of the Presbyterian Hospital in the City of New York. Vol. IV, January, 1900. Edited by Andrew J. McCosh, M. D., and W. Gilman Thompson, M. D. (*New York: Trow Directory Printing and Publishing Company.*)

It is difficult to do justice to all contributors to a volume of this kind, comprising, as this one does, twenty-two separate papers. The volume contains 223 pages. The articles are contributed by various physicians, surgeons and pathologists connected with the Presbyterian Hospital in New York.

The volume opens with a paper by F. Tilden Brown on the Surgical Treatment of Ascites due to Cirrhosis of the Liver. The object of the operation is to favor the establishment of compensatory anastomoses between the portal and general

venous system. The following papers deserve mention as being of special interest: "Remarks on the Surgery of the Biliary Passages with a Report of Ten Choledochotomies," by Andrew J. McCosh, M. D.; "Typhoid Fever in an Infant Nine Months Old—Recovery," by W. P. Northrop, M. D.; "Report of Ten Cases of Subphrenic Abscess," by Forbes Hawkes, M. D.; "A Report of Twenty-eight Cases of Suppurating Hepatitis," by Stuart Hart, M. D.; and "Statistics of One Hundred Cases of Cancer of the Breast and the results of Operation," by Clarence A. Williams, M. D.

Sajous's Annual and Analytical Cyclopædia of Practical Medicine. Volume V. (Philadelphia, New York, Chicago: The F. A. Davis Company, Publishers.)

The high standard of its predecessors is maintained in this volume. It covers the subjects from "Methyl-blue" to "Rabies" inclusive, and contains 662 pages. The editor refers, in the preface, to the loss which he and the profession generally have sustained in the death of two of the associate editors since the publication of the last volume, viz., Dr. Norman Kerr, of London, and Dr. J. E. Graham, of Toronto. This volume embraces nearly all of the specialties—otology, laryngology, ophthalmology, neurology, pediatrics, obstetrics and therapeutics.

The late Dr. Kerr has given us the advantage of his experience in elaborating the excellent article on Morphinomania contributed by the editor. Of special interest to those who have the care of infants in their charge is the article entitled "Nursing and Artificial Feeding," written by Dr. Holt and Dr. Fétra, of New York. Some of the most important diseases of the lungs are included in this volume. Pleurisy and various affections involving the pleural cavities are treated thoroughly and concisely by Dr. McPhedran, of Toronto. The instructive articles on "Catarrhal Pneumonia" and "Lobar Pneumonia" are respectively written by Dr. Solomon Solis-Cohen and Dr. Thomas G. Ashton, of Philadelphia. The specialties have had full justice done them by the various contributors, and the practicing physician will obtain useful aid in the treatment of affections of the eye, ear and throat.

Short Papers on Nursing Subjects. By L. L. DICK. (New York: M. Louise Longeway, Publisher, 1900.)

This modest little pamphlet of 57 pages contains four short sketches which are of peculiar interest to nurses. "A Pilgrimage to Kaiserswerth" gives an interesting account of a visit to the scene of the labors of Pastor Fliedner, with a description of the present condition of the old mother-house. The tale is attractively told and is interesting to all, whether nurses or otherwise.

"Nursing Organizations in Germany and England" presents very clearly the differences which exist between English and German methods of nursing. In Germany everything is arranged according to law, and little scope exists for individual or independent action. In England there is more freedom and greater flexibility in the organization of nursing. The writer's personality is displayed in her references to the English pension fund, which seems to her to be the sum of all abominations instead of a benevolent scheme to help improvident nurses to put by something for old age.

"The Nurses' Settlement in New York" is an extremely interesting and readable account of philanthropic effort. It fails to give a very definite notion of what is actually accomplished by this and similar settlements. It is hardly worth while for nurses to live among the poor just for the sake of living among them or in order to show that they can so live surrounded by similar discomforts. If the life of a nurse in the slums tends to relieve the condition of the poor or to make their lot one whit less hard, there would seem to be some good grounds for such acts of self-renunciation on the part of nurses. If, how-

ever, life in the slums is merely to demonstrate that nurses can live among the poor, the outcome would seem to be wholly incommensurate with the output of effort and self-sacrifice.

The booklet represents the views of a very earnest and faithful worker in training-schools, among nurses and among the poor, and deserves to be read by all who are interested in the work of nurses.

Embryochemical Studies. By P. A. LEVENE. (*Archives of Neurology and Psychopathology*, II (1899), p. 557.)

The article gives an account of the first of a series of researches which will have for their object the study of the changes in the chemical distribution of nitrogen and phosphorus in the fertilized egg as development proceeds. The material used was the egg of the codfish, and this was examined in four stages: unfertilized, 24 hours after fertilization, 11 days after fertilization, and 20 days after fertilization. In each case the material was analyzed as follows:

The material was dried at 105°, extracted with very dilute hydrochloric acid and phosphotungstic acid added in excess. The nitrogen of the precipitate and residue was then determined as nitrogen of proteids and bases.

A second portion of the dried material was extracted in turn with boiling alcohol, ether, alcohol, boiling water acidified with acetic acid and cold water, and the nitrogen determined in the residue as nitrogen of total proteids.

A portion of eggs was extracted with cold and hot alcohol, cold and hot ether, and dried at 105°. In a weighed portion of this material the nuclein bases were extracted with sulphuric acid and weighed as silver compounds, while a second portion of the same material was submitted to the prolonged action of pepsin-hydrochloric acid and the undissolved portion weighed as nuclein.

It will be seen that the analytical results thus obtained furnish the data for calculating any changes that occur in the quantities of amido acids, proteids, nuclein bases or nucleoproteids as the development of the egg proceeds. While the author feels that it would be premature to draw any broad conclusions from the data thus far obtained, the results point strongly to the conclusion that in the course of development the processes of synthesis are preceded by those of decomposition. In the first stage after fertilization the proteids diminish in quantity and basic nitrogenous substances are formed at their expense. Later the basic substances decrease in quantity and the proteids increase. The combined proteids (nucleoproteids) and mineral substances greatly increase in the course of growth.

A continuation of this work should bring to light matters that are of interest.

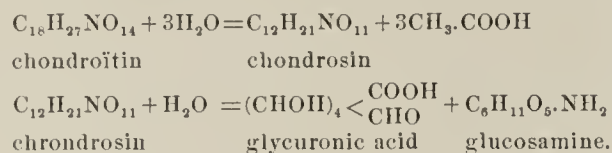
On the Absorption of Proteids. By P. A. LEVENE and I. LEVIN. (*Archives of Neurology and Psychopathology*, II (1899), p. 553.)

While it has been generally conceded that the products of proteid digestion are taken directly from the digestive tract into the blood and thus find their way to the other tissues, the recent work of Asher led him to believe that the prevailing view is based on inconclusive experimental evidence and that the principal path of absorption is the lymphatic system.

In order to test the correctness of Asher's statement, the authors performed a series of experiments upon dogs in which carefully prepared iodoproteid was ingested, thus adopting conditions which permit a clear differentiation of the proteid ingested from the tissue proteids. The ingestions were made variously in the large intestine and colon, in the small intestine and along the entire digestive tract, and the lymph was collected from the thoracic duct from one to seven hours after the ingestion; yet in no instance could iodoproteid be shown in the lymph. The experiments are very conclusive in showing that the lymph is not a path of absorption of the iodoproteids.

The Chemical Relationship of Colloid, Muroid and Amyloid Substances. By P. A. LEVENE. (*Archives of Neurology and Psychopathology*, II (1899), p. 571.)

The very remarkable work of Schmiedeberg showed that the chondroitin-sulphuric acid of the cartilage is capable by hydrolysis of producing chondrosin, glycuronic acid and glucosamine; and it has since been found that chondroitin-sulphuric acid exists in some form of combination in the amyloid substance—



Levene now finds that tendomucin is a combination of a proteid with a nitrogenous ethereal sulphuric acid very similar to chondroitin-sulphuric acid since it yields chondrosin and that submaxillary mucin, as well as colloid of a colloidal carcinoma, contains very similar or identical ethereal sulphuric acids in combination. The work points very clearly to the conclusion that colloid, muroid and amyloid substances are similarly constituted.

BOOKS RECEIVED.

Annual and Analytical Cyclopædia of Practical Medicine. By Charles E. de M. Sajous, M. D., and one hundred associate editors, assisted by corresponding editors, collaborators and correspondents. Volume V. 1900. 4to. 662 pages. The F. A. Davis Company, Philadelphia, New York, Chicago.

Clinical Examination of the Urine, and Urinary Diagnosis. A Clinical Guide for the Use of Practitioners and Students of Medicine. By J. Bergen Ogden, M. D. Illustrated. 1900. 8vo. 416 pages. W. B. Saunders & Company, Philadelphia.

A Manual of Personal Hygiene. Edited by Walter L. Pyle, A. M., M. D. Illustrated. 1900. 12mo. 344 pages. W. B. Saunders & Company, Philadelphia.

Atlas and Epitome of Diseases Caused by Accidents. By Dr. Ed. Golbiewski, of Berlin. Authorized translation from the German, with editorial notes and additions by Pearce Bailey, M. D. 40 colored plates and 143 illustrations in black. 1900. 12 mo. 549 pages. (Saunders' Medical Hand-Atlas.) W. B. Saunders & Company, Philadelphia.

Medical and Surgical Report of the Presbyterian Hospital in the City of New York. Volume IV. January, 1900. Edited by Andrew J. McCosh, M. D., and W. Gilman Thompson, M. D. 8vo. xiv + 223 pages. Trow Directory Printing and Bookbinding Company, New York.

Reports from the Laboratory of the Royal College of Physicians, Edinburgh. Edited by Sir John Batty Tuke, M. D. and D. Noel Paton, M. D. Vol. VII. 1900. 8vo. Oliver and Boyd, Edinburgh.

Atlas and Epitome of Special Pathologic Histology. By Docent Dr. Herman Dürk. Authorized translation from the German. Edited by Ludwig Hektoen, M. D. Circulatory Organs; Respiratory Organs; Gastro-Intestinal Tract. With 62 colored plates. 1900. 12mo. 158 pages. (Saunders' Medical Hand-Atlas) W. B. Saunders, Philadelphia.

Atlas and Epitome of Gynecology. By Dr. Oskar Schaeffer. Authorized translation from the second revised and enlarged Ger-

man edition. Edited by Richard C. Norris, A. M., M. D. With 207 colored illustrations on 90 plates, and 62 illustrations in the text. 1900. 12mo. 272 pages. (Saunders' Medical Hand-Atlases) W. B. Saunders & Company, Philadelphia.

Lectures on Clinical Medicine. Delivered in the Glasgow Royal Infirmary. By John Lindsay Steven, M. D. With 37 illustrations. 1900. 8vo. 195 pages. Alex. Macdougall, Glasgow.

Twenty-third Annual Report of the Board of Health of the State of New Jersey, and Report of the Bureau of Vital Statistics. 1899. 8vo. 432 pages. 1900. Trenton, New Jersey.

Lehrbuch der Nervenkrankheiten. Für Aerzte und Studirende. Von Prof. Dr. H. Oppenheim. Zweite, wesentlich vermehrte Auflage. Mit 287 Abbildungen. 1898. 8vo. XIV + 985 pp. S. Karger, Berlin.

Handbuch der Anatomie und Vergleichenden Anatomie des Centralnervensystems des Säugetiere. Von Dr. Edward Flatau und Dr. L. Jacobsohn. I Makroskopischer Teil. Mit 126 Abbildungen im Text und 22 Abbildungen auf 7 Tafeln. 1899. 4to. XVI + 578 pp. S. Karger, Berlin.

Psychiatric. Ein Lehrbuch für Studirende und Aerzte. Von Dr. Emil Kraepelin. Sechste, vollständig umgearbeitete Auflage. Band I. Allgemeine Psychiatrie. Band II. Klinische Psychiatrie. 1899. 8vo. 969 pp. Johann Ambrosius Barth, Leipzig.

Eighteenth Annual Report of the Provincial Board of Health of Ontario. Being for the year 1899. Printed by order of the Legislative Assembly of Ontario. 1900. 8vo. 107 pages. Warwick Bros & Rutter, Toronto.

THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains announcements of courses of lectures, programmes of clinical and pathological study, details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

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 WILLIAM S. BAER, M. D., Assistant in Orthopedic Surgery.

GENERAL STATEMENT.

The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital. The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter. Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.
2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study. They are required to furnish certificates from officers of the college or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otolaryngology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating-rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

During October a select number of physicians will be admitted to a special class for the study of the important tropical diseases met with in this region.

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THEODOR BILLROTH, MUSICAL AND SURGICAL PHILOSOPHER. A BIOGRAPHY AND A REVIEW OF HIS WORK ON PSYCHO-PHYSIOLOGICAL APHORISMS ON MUSIC.¹

BY JOHN C. HEMMETER, M. D., PH. D.,
Professor in the University of Maryland.

In the following paper I have attempted a sketch of the life and work of a man who represents one of the most scholarly, versatile and inspiring characters in the history of German medicine; an investigator who accomplished and perfected achievements of enduring excellence in two arts, widely divergent—Music and Surgery; or, to state it in broader terms, in Biology and Medicine as well as in the Psychology of Music. For facts here narrated I have drawn largely from the various obituary notices and necrologies in German journals, and, for the second portion, from the introductory chapters to Billroth's book entitled "Wer ist musikalisch?" or "Psycho-Physiologische Aphorismen über die Musik."

BIOGRAPHY.

Christian Albert Theodor Billroth was born on the 26th day of April, 1829, in Bergen, on the beautiful island of

Rügen. Here, in the midst of a happy family, and subjected to various intellectual influences, he spent his youth. After leaving the gymnasium he studied at the universities of Greifswald, Göttingen and Berlin, and in 1852 received the degree of Doctor of Medicine at the last-named institution. His graduating thesis on this occasion was entitled "De natura et causa pulmonum affectionis, quæ nervo utroque vago dissecto exoritur," (Concerning the nature and cause of a pulmonary affection which arises from section of the vagus). It was thought to possess unusual merit at that time.

Billroth had become so conversant with all branches of medicine during his university studies under such men as Rudolf Wagner, Johannes Müller, Lotze, Schönheim and von Graefe, that even after he had been persuaded by von Baum and B. Langenbeck to devote himself to surgery, he did excellent work not only within the limits of his own specialty, but also in normal and pathological histology, physiology, and general pathology.

To broaden his views he journeyed to Vienna and Paris,

¹ Read before the Johns Hopkins Hospital Historical Club.

and spent some time at the universities of both places. In 1853 he received an appointment as assistant to B. Langenbeck at the Royal Clinic of the Berlin University.

Under this great master, he very soon acquired the art of operating. His extraordinary skill in this direction and ability to rapidly comprehend the surrounding conditions of a case, together with his decision and steadiness of character, proved to be of the greatest importance to him.

In 1856 he was already doing good work as Privat-Dozent at the Berlin University, and a few years later he had come to be regarded as the most prominent of the younger surgeons of Germany, not only with respect to his operative activity, but also on account of his work as an investigator.

In 1860 he received a call as chief professor and director of the surgical clinic in the University of Zürich. This position at once afforded him that independence of action that was befitting him. Whereas in Berlin he had to attend to the diagnosis and treatment of disorders following surgical operations, and could only satisfy his innate yearning for original investigations by a historical and histological study of the rich material afforded by the clinic, he now, through a continuous study of the sick, could open up paths of his own. His most important investigations at that time dealt with septic fever and accidental wound infections. These studies which he afterwards continued in conjunction with his friend Weber and later on at Vienna, effected a complete revolution of thought with respect to the causes and nature of these conditions.

His "General Surgical Pathology and Therapeutics," the first edition of which appeared in 1863, showed him to be an accomplished teacher, who had illuminated with new ideas the entire field of surgical pathology and therapeutics. The work defined sharply the limits of knowledge on the subject and incited many others to independent critical study. Written in a most attractive and fluent style, it soon displaced all contemporaneous works and appeared, at short intervals, in many editions; even to the present day its attractiveness is undiminished. The publication of the ninth and succeeding editions was entrusted by Billroth to his pupil, A. von Winiwarter.

The best evidence of the great success of this work is the fact that it has been translated into the French, English, Italian, Spanish, Hungarian, Polish, Russian, Servian, Croatian, and Japanese languages.

Billroth contributed, moreover, a number of important articles relating to various branches of surgery, to the Archives of Clinical Surgery, the editorship of which he had shared with Gurlt ever since its foundation in 1860 by B. Langenbeck. He also stimulated his Zürich pupils to many investigations of importance.

When at the death of Schuh the second chair for surgery became vacant, Billroth received a call to Vienna from the Medical Faculty, upon the determining vote of Rokitansky, Brücke, Skoda, Oppolzer and Hebra.

At the very height of his activity, handsome in appearance, and in the fullness of his vigor, he accepted the chair,

August 20, 1867. Nor was it without difficulty that he finally succeeded in organizing his clinic somewhat according to his own notions, and the most necessary buildings and hygienic arrangements, as well as other indispensable improvements, were accorded to him only step by step. So great indeed was the opposition, outspoken and covert, with which he had again and again to contend, that even to the last he did not succeed in obtaining, as he had long hoped he would, either an up-to-date clinic with modern equipments, or a remodeling of the entire hall, as planned by himself.

In one respect he could claim a quick and decisive victory. The enthusiasm and love of those who attended his lectures, and the reverence and admiration of his more intimate pupils were his from the beginning to the end.

A fascinating delivery, coupled with great fluency of speech, and freedom from all doctrinal tenets, attracted everyone about him. Ideas and views quite new to his pupils were developed, and pathological phenomena, as they appeared at the sick bed, were explained in the light of the latest physiological, pathological-anatomical, and experimental-pathological discoveries. The soul of science breathed life into his teachings; the love of truth, with which Billroth was completely saturated, made them real. Here in his new sphere of duty, he inaugurated that restless activity which made him a captive for his last twenty-seven years at the Vienna institution.

"Per aspera ad astra," and "Durch Klarheit zur Wahrheit," these were the standards under which he unfalteringly moved on from victory to victory.

Perhaps his greatest contribution belongs to the domain of practical surgery. Hardly had he arrived in Vienna, when he began to compile his report on the Surgical Clinic in Zürich, from 1860-1867, which was followed by one on the Vienna Surgical Clinic from 1869-1870, and finally a report on the latter clinic from 1871-1876, together with another on both conjointly. The value of these volumes, which could only have been collated at the expenditure of the greatest of industry and through an almost infinite capacity for work, is due not merely to the important contributions to practical surgery contained in them, but much more to the fact that Billroth for the first time presented to the world a complete account of his entire experience.

Collections of statistics on various subjects belonging to medicine and even surgery had existed ere this, but no one before Billroth had had the courage to appear before the tribunal of scientific criticism with his experience in its entirety, including, therefore, that of an unsuccessful, as well as that of a successful character. In this way he stimulated others, and caused them to do likewise. The generally accepted opinion of to-day is that this manner of utilizing the statistical method in surgery is the correct one.

The stirring events of the year 1870 carried Billroth along with them. He felt it his duty to proffer his assistance, and he did so generously, both at Weissenburg and Mannheim. His scientific contributions to the surgery of the Franco-Prussian War are to be found in the magnificent letters re-

ceived from him while at the hospitals for the wounded, which form the worthiest monument of Billroth's activity as a military surgeon.

No sooner had he returned from the field hospitals than he resumed his extended investigations concerning the vegetative forms of septic cocci.

At the close of the year 1874 he was in a position to present to the wonderment of the scientific profession the results of his experience in the form of a monograph.

The wealth of observational data stored up in it, and the manifold points of view from which he attempted to master numerous problems which had presented themselves during the course of his investigations, together with those magnificent ideas which acted as the precursors of demonstrable facts, bear witness to that stupendous and ingenious spirit of investigation which impelled Billroth onward with unmerciful force, and caused him to make good use of well-nigh the last minute of his rather scantily portioned existence. Many and many a night he would remain till late at the microscope and study his specimens. During this period of time, as we learn from Gussenbauer (*Neerolog über Billroth*), Billroth worked for months at a time from 16 to 18 hours a day.

Hardly had he finished this stupendous task, when he undertook an investigation in a direction apparently remote from his immediate profession. He gathered information concerning the arrangement and character of medical studies prevalent at the universities of all countries. He took an interest in this subject as no one had done before him. The outcome of his study was a book, "How to teach and study the medical sciences." It created a sensation at the time being, particularly in Austria. It aroused much opposition on account of the plain truths which Billroth unhesitatingly and without heed of possible consequences had expressed in it. Although many of his opinions may be now considered as rather too rigid, his book is still, and will remain for some time to come, a veritable treasure-house of the grandest ideas. His views have been accepted as the most practical dealing with the organization of medical instruction.

Over and above this activity—so extensive as to have alone furnished ample employment to even an exceptional mind during a lifetime—he wrote a long series of essays and papers in which he clearly defines his position with respect to everything of an important nature evolved within the department of surgery and pathology during the course of many years.

His monographs on wounds and their treatment, on scrofula and tuberculosis, and on diseases of the mammary gland, contained in the joint treatise on surgery by von Pitha and Billroth and in *Die Deutsche Chirurgie*, are graphic models of lasting value, and everywhere mark the expert clinician and physician.

His historical and critical studies on matters relating to the transportation of the sick and wounded, on nursing as practiced at home and in the hospital, show the lively interest he took in everything which was intimately connected with the cure of his patients.

Even during the last years of his life, when illness began

to annoy him, with constantly increasing intensity, he managed to keep himself thoroughly informed on all new discoveries in the spheres of surgery and pathology, and enlarged and supplemented them out of the rich fund of his own experience.

Many an idea which he has embodied in his treatise on the "Reciprocal Influence of Living Plant and Animal Cells," published in 1890, may be expected after thorough investigation to develop into facts of lasting utility.

At the inauguration of the Building of the Royal and Imperial Society of Physicians, Billroth made use of the occasion to summarize his entire experience on the treatment of aneurisms, and discuss the relative values of the various methods suggested.

Over and above all his very numerous publications, which show Billroth to have been one of the most productive and influential medical authors of the present century, he took upon himself an immense amount of the work involved in the editing of the *Treatise on Surgery* by Pitha-Billroth, of *Die Deutsche Chirurgie* by Billroth-Lücke, of the *Archives of Clinical Surgery* by von Langenbeck.

From Gussenbauer² we learn of still another treasure which Billroth has stored up in the course of decades. This work has not as yet been made public; only those who attended his lectures and his intimate pupils have had from time to time an opportunity to get a look at it, and appreciate what Billroth was doing in behalf of science at the cost of immense labor and a large expenditure of his own money.

I have reference to his collection of illustrations of diseases of rare occurrence, executed under his direction by celebrated artists. His long-conceived plan had been to incorporate this collection in a comprehensive work on special surgical pathology. It was not his good fortune to carry out this magnificent idea. His bodily powers did not suffice towards the end to keep pace with the onward movement of his indomitable intellect.

And what did not Billroth accomplish as an operator! Unequaled on the technical side of his art, and urged on by the noblest sympathy with the sick to help where others had failed to do so, he strove to extend the boundaries of practical surgery, and succeeded as no one before him had done.

Experimental studies on animals were first carried out, and not until the results of these, supported by all existing knowledge of the human body made the final outcome of the well-conceived operation promise more than a probability of success, did he proceed to the rescue of the otherwise doomed. His resection of the esophagus was followed by his extirpation of the larynx; these led to resections of the stomach and intestines and finally to extended innovations in the field of intestinal surgery, the limits of which have not yet been reached. To Billroth belongs the honor of having performed the first successful extirpation of the larynx, as well as the first successful resection of the stomach.

As a teacher Billroth stands preeminent, for while train-

² Gussenbauer, loc. cit.

ing his numerous pupils in the ways of thinking, which his experience had taught him to be the best, he constantly incited them to undertakings of their own, and was ever ready to place at their disposal all the wealth of his own far-reaching knowledge. The force of his own brilliant example, and a certain subtle ability which he possessed of discerning the individual traits of each one, rendered his influence over his pupils all-powerful. Any one who had within him a genuine striving after progress was welcomed by Billroth.

In addition he seemed to have the rare power of forming a just estimate of differences of character. So unprejudiced and loving was his heart, so comprehensive his intellect, that he was capable of attracting to himself even those of unlike aims and wishes. Billroth's enthusiasm and energy of mind live again and flourish in his pupils.

And finally, what was he not as a man! Although coming from a family in which sickness had found an abode, nature nevertheless had amply endowed him with comeliness and strength of body and at the same time had equipped him so richly with sterling qualities of mind and heart, such as are not likely to be soon found united again in one individual. By means of strict, even unrelenting, education of self, he developed into that ideal model as he appeared to his pupils even to the end of his days.

He was a homogeneous whole, not one-sided, as is wont to be the case with so many professional men. His excellent musical capabilities were used to advantage and developed to such an extent that indeed, up to the very end, he obtained solace from this source whenever the grave and onerous duties of the surgeon threatened to oppress him. In comprehension and critical estimation of the masterpieces of the art, he could hold his own with the most famous artists and professional critics.

Wherever Billroth happened to be, he kept himself in close touch with men of prominence in their various callings; in this way he preserved himself from a narrow view of life and its phenomena, and ever maintained an active interest in everything that concerns the beautiful, true and good.

Nor was Billroth averse to the ordinary pleasures of life, considering them a necessary means of diversion for the mind. The decorations of his home, that magnificent Villa Billroth on one of the most beautiful spots on the Wolfgang Lake, were prompted by his own taste for the beautiful, and a desire to make his own, as well as the lives of those around him, as agreeable as possible.

Billroth may be certainly said to have been singularly rich in true happiness and honors of all kinds. Happily married in 1858 to Christel Michaelis, his domestic life was not without its trials and tribulations. His son died in Zürich, his daughter in Vienna. To his three remaining daughters he transferred all his fatherly love and care.

Among his personal friends and intimates were numbered members of many prominent families both in and outside of Vienna. To his numerous pupils whom he constantly assisted with his fatherly advice, and to whom, when in need, he oftentimes lent a helping hand, he proffered the hospitality

of his house. And here, within the circle of his family, Billroth disclosed the real man, possessed of all the truly magnificent qualities of mind and heart.

These very qualities, combined with a refined artistic instinct, chained him to Vienna, the city of the musical muse. Here he very soon felt at home; he became an Austrian and a warm patriot. His Austrian patriotism compelled him, a man from the North, twice to decline honorable calls to prominent universities of United Germany. In the year 1872 the University of Strassburg, which, during its reorganization, was richly endowed, offered him a professorship. After the departure of Jüнкens from Berlin, he received a call to the Charité Hospital, but again declined. And even when Langenbeek himself, on his retirement from the most important surgical chair of the German Empire, declared Billroth to be his most worthy successor, the latter could not decide to return to his fatherland. He had found his home in Austria; he remained at the Vienna University. His only immediate reward was the grateful cheering of the Vienna students.

Proofs of his patriotism still remained in his creations of a benevolent character in Vienna. The Rudolfiner Association, with its grand hospital in Oberdöbling, and the building of the Royal and Imperial Society of Physicians in Vienna, are his works. Only a Billroth could have accomplished this work.

He was the recipient of a large number of decorations and distinctions from his own and foreign governments, as well as from many learned societies. Among the former he possessed the Russian Iron Cross—conferred for display of extraordinary bravery while in action with the enemy. As regards American Societies, he was a member of the Academia Chirurgia, of Philadelphia; the Pathological Society, of Saint Louis; and of the Societas Chirurgica Americana, of Washington.

Such was Billroth! This man won the hearts of all who knew him. He was honored and revered in numerous foreign countries, wherever the fame of his deeds had penetrated. Nor is he forgotten after death. The imperial capital assigned a grave of honor to him, and countless was the human throng which followed his hearse in deep sorrow for the man and for the scientist. His works and his fame among men still live and will live after him.

The circumstances under which Billroth's book "*Wer ist Musikalisch*" came to be written are stated in the following introduction written by his musical friend Ed. Hanslick:

Billroth at an early age gave evidence of love and talent for music, which, as he himself always insisted, was hereditary. His grandmother, Frau Wilckens, née Willich, filled an engagement at the Berlin Opera House as soprano, alongside of the then famous tenor Eunicke—the first "*Florestan*" of Berlin—was also the grandfather of Billroth's wife. "In this way," so wrote Billroth to Hanslick, "I am truly a child of Music and the stage." When a boy he expressed the earnest wish to devote himself entirely to music, but his in-

tion was thwarted by the determined opposition of his mother, for which, however, later on he was deeply grateful. Not that this vigorously minded and cultured woman desired to suppress a love for music in her children; quite the contrary. There is still a letter written by her from Bergen, in which she reminds Theodor to give regular piano instruction to his younger brother punctually; both brothers were then studying in Berlin. Music remained Billroth's tried and beloved companion until the end of his days. During the years of his professorship in Zürich a string quartet met at regular intervals at his house, and on these occasions he himself played either the viola or second violin. He also wrote musical criticisms for the "Zürcher Zeitung," and exerted an inspiring influence on the musical life, then at a somewhat low ebb, in that city. Being not only a good performer on the violin and piano, but also a refined connoisseur and earnest thinker in musical matters, he felt during the last years of his life an ardent desire to arrange, clearly outline, and write down his views concerning music. In this matter Hanslick gladly urged him on, inasmuch as he, through his two-fold position of expert musician and trained physiologist, appeared to be unequally fitted to throw light on that line of demarcation at which musical effects and the experience of our nervous system meet.

Billroth's work progressed bit by bit, and was often interrupted. He only succeeded in doing consecutive work on it, at long intervals, during his vacations in St. Gilgen or Abbazia. During the summer of 1888, he seems for the first time to have busied himself more constantly and coherently with his musical views. At that time he wrote from St. Gilgen:

Who is musical? This would be a heading for you for an essay. How complicated this idea is! One man is possessed of especial susceptibility for rhythm (the most elementary rhythmic principle of the human body is the heart-beat); another is endowed with a decided talent for melody (melody cannot be separated from rhythm; the articulation of the human body and its twofold arrangement, with respect to a horizontal and a vertical axis, are a part of its fundamental formation); a third man appears to be musical owing to an outspoken technical and mechanical ability (elementary principle; the pleasure experienced in overcoming difficulties as the chief result of an intensified feeling of self-consciousness); in a fourth, music seems to be the expression of an intense exhibition of emotion as displayed in dramatic expression (elementary principle: a desire to appear to be of as much importance as possible, as seen, for example, in the pheasant when he strikes a wheel before the female); in another, musical talent seems to be the result of a well-developed faculty for the retention of tone-combinations and rhythms; again, in another, music means a predilection for purely sensuous effects on the auditory sense, etc. To me it is all chaos. It pleases me to deceive myself (that is no idle dream of mine), that sometime I may be able to write something sensible concerning matters outside of my profession; and that it is only the short extent of my vacations that prevents me from developing within me some mature thoughts. I like to think this, I say, although I am well aware that it is a delusion. Similarly, in my chosen profession, I have only given the incentive, have acted only as pioneer and blaster; as soon, however, as the ground was cleared, the road made, the

blasting done, I gladly let others do the sowing and harvest the results.

In a letter of September, 1890, Billroth again refers to his undertaking:

Your kind encouragement has finally begun to bring about a realization of ideas which have occupied my mind for years. I am now writing an essay: Anatomical-physiological aphorisms about music. Who is musical? It is to form one of a number of essays (which I think of publishing together under the title "Reflections of an Abirsee-promenader") providing that they turn out to my satisfaction. At present matters are beginning to swell like Faust's poodle behind the stove, and I am afraid that the book will represent only the lucubrations of a vagrant pedant. It supplies me, however, with a fund of pleasure; whether it will do this for others is, of course, a question of another kind.

One year later, in September, 1891, Billroth wrote from St. Gilgen:

About a year ago, here in Abbazia, I wrote a fairly large manuscript—"Aphorisms on the anatomy and psycho-physiology of musical matters." It remained untouched for a whole year; I have now taken it up again. The first chapter, "Concerning rhythm as one of the most important elementary principles of music, and one most intimately connected with the human organism," was fairly satisfactory to my critical judgment, so that I made a fair copy of it. The beginning of the second chapter also, "Concerning the relation of pitch to the human organism," seemed good. But after that consideration other kinds arose—speech, song, vowels, harmonics. I began to question the accuracy of some of my statements. This led me to read Helmholtz, which I did at first only cursorily, but after taking up Landois' book on "Voices of Animals," I came back again to the former. I used the fourth edition, which contains much new matter as compared with the first which I had studied years ago. A consideration of vowels, harmonics, speech, etc., brought me into the sphere of psychology—concerning the evolution of speech and song in the child—and in this way to Preyer's highly important, somewhat voluminous, but nevertheless interesting treatise. I really do not intend to write anything of a learned nature, but wish to clear away false notions about such matters from the minds of amateurs. Is the process of composing intimately related with the phenomena of hallucinations or illusions? This forced me to resort to a book on hallucinations, sleep, dreams, etc.; indeed, it led me to a study of mental diseases. I do not care to write a line which might convey the least uncertainty about such matters, nor to use a single word in an erroneous or equivocal manner. . . . Now I have certainly read so much of real excellence, that, for the present at least, I am too timid to look at my manuscript. You can see that I am not destined to become a popular writer. I readily pass over inaccuracies on the part of others so long as the authors interest me; but every statement of my own I weigh with intense seriousness. Thus my contemplated essay can hardly expect to ever become a realization. No matter! If such a work is ever needed, it will be written by some one else. What is occupying the mind of one person at any given time is receiving the attention of hundreds of others.

At last, November 21, 1891, Billroth sent Hanslick a part of his essay together with the following letter:

Although you have often encouraged me to commit to writing various of my views on music, expressed in conversation at one time or another, it is with some feeling of anxiety that I send the enclosed manuscript. If you will read it at your convenience,

you will please me very much. I have written down these ideas partly because I wished to be better able to form an opinion of their real meaning, and partly from the mere pleasure of producing something. But I do not intend, at least for a long time to come, to hand them over to publication. While writing I have kept before my mind the needs of a fairly educated public, but have earnestly endeavored to avoid medical or philosophical cant. In the first two chapters sent you, I think that everything has been gone over which might be designated as "Musical Physiology," or "The Physiology of Things Musical." The remainder is based on conventions. But inasmuch as convention depends on the psychology of the human being with respect to his position as to social or gregarious animal (*ζωον πολιτικόν*), and on psycho-physiology—because of the inseparability of the soul and body—the following portions of this work may be considered appropriate so far as regards the main title.

It is interesting to observe in a man of Billroth's reputation that shy modesty, in connection with his work, displayed—in various letters to Hanslick—such a diffidence as regards his knowledge and style. It must have been a fear lest he should write too learnedly or as a pedant that induced him at first to prefix to a number of chapters musically humorous headings, viz.: I. Marcia (like a march); II. Allegro serioso, ma non troppo (at a not too serious gait); III. Grave (with gravity); IV. Thema con variazioni (theme and variations); V. Serenata (serenade); VI. Intermezzo (interlude); VII. Finale tempo giusto (conclusion at a good gait). These headings, present in his first sketch, he afterwards changed. The title "Who is musical?" was originally prefixed only to the last chapter. It was finally, but perhaps less appropriately on account of its limited meaning, selected as a title for the entire work.

Shortly after Billroth's death at Abbazia, on February 6, 1894, his son-in-law, Dr. Otto Gottlieb, brought to Hanslick the somewhat voluminous manuscript on the cover of which was written in bold script the following: "This manuscript is to be handed to my dear friend Ed. Hanslick, to be disposed of as he deems fit.

Abbazia, February 3, 1894.
TH. BILLROTH."

The first three chapters appeared in "Die Deutsche Rundschau"; the complete work was not published until the fall of 1895. In a prefatory note Hanslick says: "In his manuscript Billroth designated the first two chapters as finished. The later ones demanded a more careful revision on the part of the editor because of the many illegible corrections, supplementary remarks, and inserted additions. I have tried scrupulously to avoid interfering with Billroth's mode of thought, and style, and have therefore confined myself to making only insignificant changes in some expressions and in removing many needless repetitions.

"The last chapters, although not so polished as the first ones characterized by Billroth as 'finished,' are not less important and rich in content; in fact, they possess for my emotional sense a somewhat unique, and indeed a greater charm, owing to their informal freshness, which is suggestive of a personal discourse."

THEMES FROM "WER IST MUSIKALISCH?" OR PSYCHO-PHYSIOLOGICAL APHORISMS ON MUSIC.

Billroth's work is an attempt to fill a gap that exists in the literature of acoustics, and of esthetics. Helmholtz, in his "Sensations of Tone," attempted to connect the boundaries of two sciences—physical and physiological acoustics on the one side and esthetics on the other—which, although drawn toward each other by many natural affinities, had before his time remained practically distinct. Works on physical and physiological acoustics are by no means rare, and of those dealing with esthetics, pure and simple, there is an abundance. Ed. Hanslick, has ably covered the ground of musical esthetics in his book "On the Beautiful Music" (*Ueber das musikalisch Schöne*). Billroth makes a modest and largely successful effort to construct a road through the almost unknown territory of the purely psychological in music. The book, as edited by Ed. Hanslick, is called "Wer ist musikalisch?" the title being that given by Billroth to the last chapter in the book, and designated by him as a sketch. The selection does not seem to me a very happy one, inasmuch as the title by no means represents the matters treated of in the volume.

The book contains some 250 pages, and is divided into seven chapters. The first treats of rhythm, an essential element in music, which is intimately associated with our organism. Nearly all human beings and many animals are agreeably moved by repetition of rhythm. Human beings feel induced to execute similar rhythmic movements with their body, particularly with the head and hands. This may be explained on the ground that the movement felt as a rhythm acts upon certain properties of our body, which are known to us from experience and to which we are accustomed by practice and exercise, so that the perception of a rhythm may be transformed without reflection into a rhythmical movement.

Rhythmic movements are among the most important properties of our body, and are necessary to life. Thus for instance, we have rhythmic movements of respiration, rhythmic movements of the heart, and the rhythm which we are capable of imparting to our voluntary muscular movements. It is probable that all muscular movements of the body, conscious or unconscious, are brought about by a summation of numerous infinitesimal and imperceptible rhythms.

The psychic contagiousness or power to cause imitation which rhythm exercises upon human beings is well known. The psycho-physiological law of sympathetic movements and sympathetic sensations (*Mitbewegung und Mitempfindung*) has such a wide distribution in the animal world, and is of such eminent significance for our entire social and ethical culture that it gives the impression of a fundamental natural law applying to all organized matter. The effect exercised by human beings upon one another is based upon it. When Billroth speaks of sympathetic movements and sympathetic sensations as the results of a transference of psychic and physical rhythm, he has mainly in view the transference of a

movement or sensation, through observation by the senses, from one individual to another. Speaking purely physiologically, sympathetic movement is often used to describe the transference of excitation from one motor nerve to another, and sympathetic sensation would mean the transference from one sensory nerve to another. This latter conception has little bearing upon Billroth's consideration of rhythm.

It would lead me too far to enter upon a consideration of the powerful social consequences of sympathetic movement and sympathetic sensation, in which we must, according to Billroth, recognize one of the strongest foundations of ethics. He next considers the tendency to appreciate rhythmic movements as it is continuously impressed upon us by observation of our fellow creatures, men and animals. In an entertaining manner the rhythms of the movements of a horse are described. The walk is compared to the Andante (2/4), the trot to the Allegro (2/4), the gallop to the Allegro con brio (3/8), with a 1/16 up-beat (*Auftakt*), the canter (Presto 2/4). The description of the rhythms in the walk of hens is almost comical, while the recognition of those hidden in the call of the cuckoo, of the quail, and of the cock, shows an analytic and careful observer.

Billroth asserts that a fundamental condition of music, viz.: the more or less conscious ability to receive and appreciate rhythmic movements, must be innate in man and many animals. This question is intimately associated with the problem whether the aspects of time and space are also innate with us, *a priori*, in the sense of Kant. Billroth's opinion is that these capacities are born in us, but they can only become conceptions by experience. The perception of rhythmic movements occurs with varying intensity in different individuals, and it may or may not lead to sympathetic movements. The event will depend upon the power of observation and experience on the one hand, and, on the other upon the greater or lesser irritability of the nervous organs, and also upon the degree to which excitation can be transferred from the tracts of special sense to the motor paths. The quicker or slower propagation of nerve excitation, is a quality that may be innate, or may be developed by custom. Every one has noticed the difference between vivacious and phlegmatic temperaments. Most European nations, particularly the Romance South Germanic, and South Slavic tribes, are in general of a quick, vivacious disposition, and love this temperament in other men; whereas the inhabitants of the North, as well as the Oriental nations, have a quiet temperament, and give preference to this also in other people. Of course there are individual exceptions. Religion and custom in certain great tribes have in a few instances idolized the acquisition of the greatest possible indifference in temperament, including not only the suppression of every individual motion, but the encouragement of the greatest possible independence from surrounding stimulations. Similar principles, according to Billroth, constitute the highest ideal of human perfection in the education of the English nation. The freest and the most perfect individual is the one who can appear independent of all external influences, like a

rock in a stormy sea. To be moved or to show emotion under the influence of environment means to become ridiculous; such Billroth conceives to be the force of English custom. Inquisitiveness and the pleasure caused by changes in the external environments, are not totally excluded, only there must be no expression of this sensation. This is an Oriental trait. Whilst the powerful significance of such innate and acquired peculiarities of character are not to be underestimated for practical life, nevertheless, so far as the appreciation of music is concerned, such men are wanting in the most fundamental requisite. Individuals who have no perception of joy or pleasure resulting from sympathetic sensations or sympathetic movements, and in whom the expression of any possible joy has been gradually deadened by education, must of necessity become unmusical.

It is a commonly accepted view among the laity that the feeling for rhythm is innate in every man. Billroth disproves this idea by a number of statistics from Austrian and Hungarian regiments indicating that in some regiments there are recruits, amounting to 2 per cent of the total number, who never learn to march rhythmically. These men are not permitted to appear in the parades, or are transferred to cavalry regiments. Besides these there are always about 20 to 30 per cent of recruits coming from Roumania and Bosnia, the mountainous countries, who remain awkward; sometimes they imagine they march well, and are surprised when they are criticised. In a Polish regiment there were to be found soldiers who had served 10 or 12 years, and who nevertheless could not march rhythmically. Some of them would march passably well when they were in the ranks, where they could watch the feet of other soldiers and be guided by their eye, but they could not march by themselves. It is therefore correct to assume, that the rhythmical feeling is not innate in all human beings, and that there are some who cannot even be taught to appreciate rhythm. They must be absolutely unmusical, for the ability to apprehend the rhythmic organization of tones into a melody is the fundamental and first condition for the comprehension of music. The popularity as well as the longevity of certain music, depends far more upon the rhythmic, than upon the melodic property. All the songs of the people are constructed in a very simple rhythm. The rhythm of a melody, in order to be popular, must not only be short and simple, but must frequently be repeated in the same manner.

From popular songs the author turns to a consideration of popular dances; and in an interesting paragraph gives suggestive historical facts, tracing back the dances among the mountain inhabitants of Austria to those of ancient Greece. This section is of unusual interest, but can only be touched in a cursory manner. The dance is one of the oldest arts spoken of in history. Simonides calls it mute poetry. It would be interesting to know how David danced before the Ark of the Covenant; what was the step of Louis XIV in the minuet; what was the dance that Aspasia taught Socrates, and that of the guests at the banquet of Xenophon.

But to go back again, rhythm is asserted to be more im-

portant for the longevity of a composition than melody, because it is the more elementary of the two, and is more intimately associated with certain fundamental properties of our body. Melody is always more or less dependent upon conventionality, upon habit, and fashion. As illustrations we may take the compositions of Händel, Marcello, Bach, and Searlatti. The melodies of these masters appear strange to us, and their harmonies monotonous and occasionally ugly and bizarre. What has perpetuated these compositions, according to Billroth, are the incisive energy and the abundance of wonderful rhythms. Many great masters in music have lived after them, but they could not create anything more powerful and impressive than the rhythms of these composers. It seems that the creation of magnificent rhythms in music has been exhausted—a condition analogous to that as existing in drawing and painting, and in the disposition of space in architecture. Both seem to be exhausted since the productions of the masters of the renaissance period. Billroth does not consider that R. Wagner's compositions have become extensively appreciated, and what popularity this master has obtained is due to the exquisite rhythm in the beautifully-formed Wagnerian Motives. The endurance of Meyerbeer's four great operas is attributed principally to the great care that had been bestowed upon the rhythmic development of his music. When the sensation for rhythm has entered consciousness as a pleasant perception, and when it has caused sympathetic sensations and motions, it becomes incorporated in memory, and we begin to combine and play with these inner musical conceptions. It is an interesting, fascinating, and esthetic playing of our fantasy. By playing Billroth does not mean toying or trifling, but rather the association and combination of musical memories and conceptions. We could not say, if we are conscious of such melodic and rhythmic cerebration, that we are playing, but we would have to say as the Germans

“Es spielt in uns” (It plays in us).

This playing may be a partly unconscious and a partly conscious and active process with us. Thus a philologist or a poet plays with language conceptions; a mathematician plays with numbers or geometric forms; a painter plays with visual forms and colors, and so forth. Why one individual plays more particularly with one form of conceptions, and another with others, and why in one person one group of conceptions will remain in memory, and another group be forgotten, depends in the first place upon his organization, and the inherited peculiarities of his character. In every man will be fixed those perceptions of the senses, for which he has inherited the greatest receptiveness and ability for comprehension. This play of the conceptions leads to various results and actions which will vary according to the talent and character of the individual, and according to the characteristics of the human beings into whose society he is born at a certain time.

The acuteness and distinctness of musical perception depends upon three properties of the mind, which may be partly inherited and partly acquired. These are the following:

I. *Memory for Rhythmic Forms*.—An individual who does not possess this ability, or who cannot acquire it; who cannot recognize the repeating individual rhythmic structures in a continuous composition; who, for instance, has forgotten the beginning of a musical sentence at the end of the same, is not capable of the perception of genuine pleasure at the hearing of complicated rhythmic combinations.

II. *Pleasure at the Change of Conceptions*.—This capacity, which is peculiar to man, and in animals possibly occurs only in the highly intelligent that are in constant association with man, is inactive in indolent human beings.

III. *Pleasure at the Increase of Conceptions, and the Augmentation of Memory. Pleasure at Overcoming Difficulties*.—There can be no doubt about the elementary significance of rhythms, and the arrangement of modern music into measures, when one reflects that the attractive and charming cooperation of several instruments or several voices is inconceivable without rhythm and measured arrangement. The effect of various rhythms in causing certain sensations and conceptions, is of interest. A rhythm that we hear, or a rhythmic motion which we see, may cause a direct sympathetic movement in us. For example, we begin to beat the time with the hand when we hear music, or we feel induced to imitate a rhythmic movement which we see others execute; but the same sources of excitation may cause other conceptions by association; such for instance, as may have been deposited in our memory on former occasions by or simultaneously with that particular rhythm. For instance, dance or funeral music may remind us of a joyful dance or of a sad funeral. There may even be recalled to memory conceptions of certain persons, whom we met at the dance or at the funeral. All at once a definite landscape, a hall, a room, or the inside of a church with all its detail, may appear before our mind's eye, and we may be moved by the identical sensation that filled us when we heard similar music and the same rhythm for the first time.

Rhythm may effect an accelerating and inhibiting influence upon the psychic movement, the frame of mind in which we are momentarily. This leads the author to the question whether rhythmic movements alone—simply as such—are capable of expressing or communicating anything. This of course is associated with the question whether music without words can express ideas. That this is possible to a high degree, is evident, and an analogy is found in the so-called language by gestures. Rhythms may be perceived simultaneously by three senses. They may be heard, seen, and felt in our muscles. Now, as the influence on consciousness may be exerted from three senses at the same time, it is evident that the major part of our nervous system is occupied in the process—a fact which readily explains the marked effect exerted upon the entire organism. The relation of rhythm to several senses simultaneously has been described by Aristides.³

Billroth next compares rhythm in motion with rhythm at rest—*symmetry*. Moving rhythm is the arrangement or disposition of time, while symmetry is an arrangement and or-

³ Westphal, Griechische Rhythmik, page 47.

ganization of space. This close connection with thoughts on the rhythm and harmony, as expressed in painting, sculpture, and architecture, explains the author's inquiry as to whether the perceptions of rhythm and those of time and space are innate (in the sense of Kant).

In the third chapter, an abstract of which follows, Billroth deals with the development of the musical with the science of music.

The term Physiology (Natural Philosophy, Physiology of Man, the science of dealing with the functions of the human organism), in recent times, has often been employed in popu-

pear to most people as distinct, separated from the body. This I find very natural! The entire development of the civilization of mankind, its power, though limited, over many forces of nature, the comparative comfort of the ruling classes in the social divisions created by themselves, have not developed from the purely physiological, physical struggle for existence, but are victories which, especially in historic times, have been won principally with psychic weapons that are continually being forged in the smithy of the human brain. We cannot, therefore, be astonished that the psychic appears to the man who has not received an



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lar works in connection with matters that refer far more to culture than to nature;⁴ whence has arisen much confusion concerning the character of the "original" or "natural," and its relation to the acquired or artificial. On this account I consider it necessary to explain here that we, with what has been previously said (in the first and second chapters), are at the end of our purely physiological considerations, in so far as they are related to music, indeed, that we have already crossed its boundaries here and there and touched upon the domain that has been acquired by purely psychological work.

The soul (Psyche), according to the views of the present time, is not to be separated from the body, and the phenomena in its domain, therefore, form a very essential part of physiology. Nevertheless these phenomena ap-

⁴ Physiology of the Social Body (Schäffle), of Law (Stricker), of Love, of Hate, of Marriage, etc. (Balzac, Stendhal, Mantegazza, Bourget).



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education in natural science, as something distinct, higher, separated from and controlling the brute force of the body.

And yet the soul is more dependent upon the body than the body upon the soul. What we call perception, thought, conception, consciousness, could come into existence in the absence of a brain. To be sure, there exist, not only in the lower animals but also in man, unconscious bodily sensations and bodily motions (reflex motions) which take place without the so-called psychic phenomena, as in a well-constructed machine.

It seems not only inadvisable, but, in the present condition of society even absolutely harmful that in popular works so much stress is laid upon the dependence of the soul, because the constraint of the will is naturally connected with it. To such a degree does the entire structure of human society rest on the social dogma of the freedom of the will and on the consequent responsibility of the individual for his actions, that the beautiful edifice would be shaken to its foundations if

everybody were to maintain that all his thoughts and actions were nothing but the result of phenomena in his body, conditioned by his individual bodily constitution, his inborn psycho-physical character, for which he could be made responsible as little as for his existence. Indeed, as one of its great aims modern investigation has set itself the task of explaining the development of all ethics, as well as the rise of religions, as purely psycho-physic necessities, and as the natural consequences of the structure and composition of the human organism. But even if we were beyond the very first beginnings on this path, I should consider it dangerous, as yet, to practical ethics, to raise the veil from these mysteries of our temple of sciences before the populace.

Without going further into these and similar considerations, let it suffice to say here that the term "psycho-physical" or "psycho-physiological," as used at present, is applied not only to the connection of the qualities of body and soul but also to the treatment of psychology by means of physiological methods. If, therefore, that which I have still to say about the "Musical" does not belong to the domain of the purely physiological, it nevertheless is included under that of the psycho-physiological. I will go still further and put the results, due to social forces, of certain concessions and compromises in the domain of the musical—the "conventional"—also in the domain of the psycho-physiological.

"Conventional" and "natural" are in a certain sense antitheses. But to simply identify conventional with unnatural is in itself wrong. No creature can do anything that is not made possible for him by his natural organization; the unnatural cannot at any time be acted or even thought by man; for man cannot think anything else but what the nature and organization of his brain allow him to think. The conventional is the natural result of human striving toward conditions that bring advantages and give pleasure; it is one of the results of and at the same time one of the conditions underlying the existence and advancement of human society; it is not imposed upon society by tyrants, heroes or gods, but imposes itself, just as law and custom, and like these, it varies in its practical consequences according to place and time. The formal development of the conventional requires, to be sure, one, sometimes more, personages; these are the typical expressions, to a certain degree the embodiment of a determination or will of society (*Gesellschaftswillen*) or of the people (*Volkswillen*) in a certain time—a determination which has not yet come to a definite expression. They become leaders, lawgivers, heroes, and to us, if the mental tendencies of a long past form of society are not well enough known to us, they may appear as arbitrary tyrants, although in reality they were the slaves of the spirit and the will of their times. The same holds true for the rise of fashions; the need of society for change arises from a similar need in the individual; attempts are made by this man or that man to take the lead; whoever finally strikes the taste of the majority becomes leader. "Fashionable" and "Conventional" are terms for the same psycho-physiological processes in the

organism of human society. *In this sense the conventional also belongs to the nature of man and of human society.*

After these explanations of terms to be used later on, let us return to the "Musical."

It is justifiable to assume that the feeling for rhythm and the power of perceiving differences in tone pitch, tone sound and tone strength, as well as the capacity of differentiating these qualities in rapid change and combination are the physiological prerequisites for what we now call musical. Nevertheless, that everybody who has these qualities, is *ipso facto*, according to the customary use of language, to be called "musical" must be unconditionally denied. Does every man, unless he has been born absolutely deaf, possess the aforesaid psycho-physic qualities? This question cannot at once be answered in the affirmative. We cannot observe the inner phenomena of another man directly, but only deduce them indirectly from his physical utterances, especially from his reflex motions or his motions of accompaniment or imitation.

If we take as a standard for the rhythmic sensibility of a man his ability to correctly accompany seen or heard rhythmic movements, or to imitate them, we should occasionally, although seldom amongst civilized peoples, find persons apparently incapable (refractory) in this respect. As was pointed out above there are men whom it is impossible, or at least very difficult, to get to march or to dance in rhythm. This may be based on awkwardness. One of the most remarkable examples was Beethoven: eminently successful as he was as pianist, he is said never to have succeeded in dancing in time. It is also said of the singer Malibran that it was impossible to dance with her, because she did not keep time; and yet she was very fond of dancing. In both cases the defect could hardly have been entirely due to the lack of the feeling of rhythm; it could certainly have been obviated with some practice, unless it arose from a kind of shyness to exhibit one's self before others. This, indeed, is very difficult to remove.

Much more frequently we meet with people who find it impossible to repeat accurately a tone that has just been sung, and who claim that they do not perceive intervals of quarter tones or even half tones, even when sounded together. A false note in an opera, since but few concentrate their attention entirely or largely on the music, is probably noticed by hardly a fourth of the audience; the tremolo of the singers by a much smaller part of the hearers still. A not quite accurate reproduction of a tone, so frequent, especially among beginners in vocal music, is not always a proof that the person singing incorrectly is unmusical; often it is only the result of inattentive listening and of an awkwardness in the motions of the laryngeal muscles, and can be removed as soon as the ability to perceive the impurity of the tone exists at all or can be awakened from its slumber. Singing incorrectly on the part of trained musical singers, especially on the stage, is principally due to psychic causes—excitement, fright, and also overexertion. Most people probably distinguish whether a tone is strong or weak and whether it is produced by an

oboe, a violin or a human voice. But there are individuals who seem to have no conscious sensation even for greater tone intervals, indeed even when one tone is relatively much higher or lower; they think they are imitating a song correctly when they reproduce its rhythm alone, and with it arbitrarily use first one tone, then another, or always the same. These persons, to be sure, are hopeless cases so far as regards a musical education; and yet they may be passionately fond of music with a kind of childish delight in rhythm and combinations of tones as such, just as other people take delight in brilliant colors without being in the least endowed with the artistic sense.

It is only since the appearance of the epoch-making book of Helmholtz that musical physiologists, psychologists and specialists in ear diseases (Preyer, Stumpf, Politzer, Urbantschitsch, and others) in the last decade have busied themselves in determining with greater accuracy the physiological and psychological foundations of tone sensations and tone combinations and their closer relation to the music of our era. As a result of their studies very remarkable facts have been brought to light, showing on the one hand how widely the power of distinguishing tone intervals varies in different persons, and on the other hand how much may be obtained by systematic practice, even in the case of deaf-mutes (Urbantschitsch). It would lead us too far into details to treat this more fully. Suffice it to say, that the cause is to be found more rarely in corporeal defects (consequently defective or partially destroyed organs), in the auditory apparatus than in defective afferent nerve impulses and faulty attention to complicated sound impressions. Indeed, there exists a total psychic indifference toward all sound perception, especially toward all combinations of sounds, which might be termed a harmonic nihilism, a harmonic deafness. A friend of mine, who enjoys songs, and occasionally goes with his wife to a concert, is without any perception of the agreeable or disagreeable in the combination of tones. He forms the same impression on hearing a chord of three sounds that he does when he hears five neighboring tones struck at the same time. Thus, when I played for him the air "Wir winden dir den Jungfernkranz" in F sharp major on the piano, and accompanied it in F major with the left hand; he said, "That is from 'Der Freischütz.'" I repeated the F accompaniment with the left hand and played the air in G major. I asked "Do you notice any difference?" He reflected a while and said: "I believe it pleased me better the first time."

To appreciate the fact that in a large concert hall there are a hundred or more auditors who stand on this same plane, and that there are many more to whom all variations up to a third sound as one and the same tone, so that for them there are at the most only four well-defined tones in an octave, and that for these there does not exist any incorrect playing or singing at all, must certainly cause a somewhat gruesome feeling in the mind of the artists—"Love's Labor Lost." But during the thundering applause, the musically deaf probably clap more violently than the really musical. In my

friend there was really a musical force present, that is to say, the memory for the rhythmic: he recognized the air as taken from the "Freischütz." But even this memory may be wanting and yet the individual may play the piano. A young girl who had taken lessons on the piano for two years, was practicing a piece of Mozart's, and was ready to play it for her teacher. She came somewhat late and found him sitting at the piano and playing. In order to make her presence known she asked: "What are you playing there?" The teacher turned around astounded and said: "Why, that is the piece you are to play for me to-day." "Indeed!" She then played the piece faultlessly and the instruction was continued. This lady married a very musical man. Of their three sons, all very intelligent, two are absolutely unmusical, the middle one is exceedingly musical. To give another example of an apparently unmusical person: A very musical couple had a son who seemed, when a small child, not to take any interest in music. When he was about eight years old, his mother would sing airs for him, which he, however, could not repeat; nor could he sing a note struck for him on the piano. His mother consequently considered him totally unmusical. When he was about twelve years old, he came now and then when his mother played the piano and said: "That is pretty, mama." As time went on he could sing and play correctly melodies which he had heard, and later became anxious to learn to play the violin. In this case there was a small degree of attention to sound-impressions during earliest childhood, together with awkwardness in reproducing with the laryngeal muscles the sound heard, which in turn gave rise to a sort of shyness, from fear of making himself ridiculous by unsuccessful attempts.

These three examples from my latest experience (I formerly gave the matter no particular attention) show how manifold the coefficients are which determine whether a man is musical or not musical.

I should prefer to call them, along with the aforesaid rhythm defects, tone interval defects. It is to be hoped that both are the same, for otherwise the number of the non-musical would be frightfully large, especially if the only slightly musical be also added to it, those, I mean, who are born with an appreciation of rhythm and a perception of the smallest intervals but who have no memory for music (for two successive bars) and for whom music as such has so little interest that they find absolutely no enjoyment in directing their attention to the succession of tones. Nevertheless, these persons occasionally remember airs and sing them tolerably well.

"Who then is musical?" The answer to this, apparently so simple a question, is very difficult and extremely involved, because the term music is used just as well for the beating of a tambourine as for the most complicated polyphonic vocal music. Any one who tries to answer the question must of course consider himself musical, otherwise he certainly would not make the attempt. But here there can exist self-deception, for not infrequently we hear people talking of things concerning which they know nothing and yet think they know much. I must leave it to the reader whether he holds me to

be musical and to what degree he will admit my right to give a verdict.

The concept "Music" has, as said before, become very complicated. There are various degrees (I might almost say kinds) of being musical, because the science of tones is composed of different elements, of the rhythmic, the melodious, and the harmonious, and in each of these elements there is again a purely technical and a purely esthetic element. A person may have more talent, interest and responsiveness for one than for another of these elements, just as those with talents for the pictorial arts may have more interest and talent for drawing, or for artistic composition, (lines) for coloring, or for the purely technical. The longer one ponders over the matter, the more complicated becomes that which we now call "Music," and I can only venture the bold attempt, to answer this question, after I have tried to make it clear *how that which we now call music or the science of tones arose, and how this science affects us.* Herein I am only following a scientific tendency of our age, in which we try to understand all that is about us and in us, from its origin, and which only bows down before the "inherited" or "in-born," or in other words the "marvelous" when we can get no further on in our attempts to comprehend with our sensations, observations and thoughts, the phenomena in Nature and round about us in human society. This limit is, to be sure, reached soon enough. Nevertheless, these attempts are the sole sources of that which can create new knowledge for us, and we ought not to be discouraged at the slight result of our work, which when compared with the whole, it must be confessed, is very small. "There seems to me to be no warrant that our understanding must necessarily conquer *everything* which can exist on earth."⁵

Every creature devotes its attention primarily to those sense perceptions and performs those movements which afford it an advantage in the struggle for existence, or cause a pleasant sensation (a feeling of pleasure).

The first cry of a new-born child is a purely physiological, a so-called reflex action, which reaches consciousness just as little as the first perception of the senses and of motion. It is only with the gradually developing consciousness, with the rise of the personal feeling (ego) that perception begins; the differentiation of sensations is made consciously; the attention is directed to single ones of these sensations; these are lifted up into the inner aspect, and finally there results apperception. The child, through its muscular sensations (that is through the sensations of tension, of contraction and of laxity of its muscles), gradually reaches a consciousness that certain processes within itself are connected with certain muscular motions; it then tries to call these muscular motions forth by means of images from its memory. When this is done successfully the first conception of

causality has developed in the little cosmopolitan, the steps being in the following order: Sensation, perception, differentiation, conception, will and motion—all arising out of experience. The child begins to carry out conscious movements; for instance, to cry intentionally. This has for it a quickly apparent result: as a consequence of its crying it is nursed, and now experiences the highest pleasurable sensation which it has as yet learned to know. At the same time its conception of causality has greatly expanded; the association of its concepts and its movements has led it to this conclusion: "If I cry, I am suckled." Its logic is about to develop.

Meanwhile the child hears not only the sounds which it produces itself, but soon also distinguishes different kinds produced by others. It soon learns to know the different pitches in which people speak, and soon recognizes the different tone-colors of voices. If its attention has once been directed toward the differences of these sensations, it tries to produce these variations for itself, which can only be done by means of different muscular movements, which are experienced by it. It sees and imitates many such movements (mouth positions), others it discovers by means of its own attempts. It will call forth and reproduce, more especially, those movements which are pleasurable or useful to it.

If we leave the nursery and try to imagine grown-up men in the primeval condition of intercourse, we may well take it for granted that they soon discovered how much sounds, that were produced consciously and intentionally in different pitches and timbre, assisted communication by means of visible gestures of the entire body or parts thereof. The more man became conscious of the extraordinary power of modulation of his voice by means of the play of manifold, empirically discovered movements of the mouth, tongue and gums (naturally without having the least idea of the physiological and physical processes involved) and the greater the practical benefit which he learned to draw from it as a social creature, ("political animal," Aristotle), the more he developed these "sound gestures," that is, spoken language, and in the course of time used it even predominantly for communication, and neglected the further development of speech by means of visible gestures of the other parts of the body. The visible gestures of the entire body, which even now form the principal means of intercommunication of animals, are used by civilized man only as an adjunct to speech, although among some nations (for instance, the Italians), they are still very largely used. They fall into entire disuse with the introduction of the written language as a means of communication, which, owing to the acquired necessity of connecting certain sound images with certain definite symbols, can call forth within us any desired circle of representations (Vorstellungskreis), in the same manner as the objective perception of gesture and sounds. Next to speech itself, writing is probably the greatest invention of the brain of the "political animal," because it is practically the most full of meaning.

Without the ability to perceive and produce different sounds

⁵ Helmholtz had two classes of critics of his *Sensations of Tone*: (1) Psychology objected to reduction of esthetics and emotion to physical cases. (2) Physicists and mathematicians claimed he had not gone far enough in explanation of physical cases.

in different pitches, the development of human speech would have been impossible.

Would not, however, the ability to distinguish and produce only different pitches have sufficed to form a pure tone-language? Would this not have been possible with even one tone alone? This cannot be doubted. Such a language might have been formed somewhat like the telegraph code, which consists only of different combinations of dots and dashes (shorter and longer tones); and if we imagine these dots and dashes to be variously colored (different pitches) then we would have at our disposal a richer supply of expressions. One could use in this way acute and grave tones, rhythmically combined, for the development of a tone-language, without any participation of the mouth, the tongue or the gums, that is, without the simultaneous use of different tone-colors. But such a proposition appears to me just like asking whether man, if possessed of only one leg and two arms, or of two legs and one arm, could have attained the same completeness of social development as with his present shape. The fact simply is, that he has four extremities, of which the rear ones are much stronger and longer than the front ones; therefore, he walks most comfortably upright and develops his arms and hands for all sorts of useful and pleasurable purposes. Thus man has an oral cavity which allows very great changes in form. This capacity is lacking in the majority of the higher animals, since their oral orifices reach nearly back to the rear teeth, and on this account the formation of the various vowels as well as most of the consonants is impossible for them. Man has an exceedingly flexible tongue; he has the ability to cut off the connection between the mouth and the nasal passages by means of the velum, and by means of experiments and experience he has learned not only to produce with this complex apparatus the manifold modulations of the tones of his larynx, but also to render the distinctions clear. It was more convenient for him to use this apparatus for coloring tones, employing few changes of the tones of his voice, than to develop the latter into a pure tone-language. We speak more easily than we sing, because speaking interferes much less with the breathing process than singing, and also because the laryngeal muscles tire more easily than the muscles of the oral cavity, etc. A singing in quick, short rhythmic movements (dots and dashes) such as would be requisite for a pure tone language, if the latter were to have a completeness even approaching our present tone-color language (Klangfarbensprache), would bring us so often in collision with our breathing-rhythm that the effort would become a torture for us.⁶ Man could, if he were compelled, by means of continuous practice, even in this direction perform wonders; indeed he could get so accustomed to

the system that he would no longer experience its discomforts. If such a style of speech were to become the fashion, who knows what would happen!

It is still a long way from speech to song and thence to music, and yet, according to my conviction, song (even if not all music), developed out of speech. I imagine the process to have been somewhat as follows:

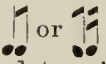

To the original "sound-gestures" belong especially the words of address, exclamations and interjections. Tones, lasting for a longer or a shorter period, are uttered strongly and repeatedly, as the mimical expression in sound (klang-mimischer Ausdruck) of a condition of sensation. This probably was, in the beginning, a purely reflex process, analogous to the cry of the new-born child, but soon became a consciously used, useful means of expression. In very loud speaking, in the public, loud praying of priests it was found especially effective with the audience, to at one time raise the tone of the voice, at another to lower it; possibly this was not at first intentional and occurred as a natural result of the exertion and fatigue of the laryngeal muscles. Most people end a sentence with a lower tone than that with which they started—a tone-falling or cadence. To emphasize single, especially important, words, the voice was raised to a higher plane; by this means the speaker succeeded better in retaining the attention of the hearers than by talking in a monotone pure and simple. The more strongly breathed word becomes somewhat higher, just as the gas jet becomes brighter on account of the stronger pressure in the service-pipes. Stronger intonation is at the same time unintentional tone-elevation; but the speaker also often goes to a higher level; the orator intentionally uses different tone-elevations; his speech is, by the side of sound-gesture, also tone-language. In ordinary conversation we keep probably within a fifth; in excited discourse we probably use an octave. These aids to expression were probably used more especially by priests, seers, prophets, orators and narrators; they simply proved to be useful for the attainment of the desired effects. From such a pathetic way of speaking to a half-singing reciting is an easy step, and finally a scarcely noticeable transition. Soon the priests prayed almost altogether in a singing tone. This custom came over from the Greeks and the Jews into the Christian Church, and was there developed in several directions. In all these cases the singing tone serves only as a practically useful strengthening of the expression. The tones of speaking still rule over the tones of singing.

Tones and words, when they are both connected in similar rhythmic members, approach more nearly what we at present call vocal music. Herein also one of the most important factors of music is developed—a *division of tones into a definite succession of intervals*. In ordinary speech one can let the tones of the voice run into one another without becoming actually indistinct; the thorough comprehension of a verse rhythm requires more sharply differentiated tone intervals. Finally, the verse brings with it the most important element for the form of music—the repetition of the same or similar, larger or smaller rhythmically formed parts. The single

⁶ The birds have predominantly a tone language. The parrot, on account of his thick, very flexible tongue and the shape of his relatively short oral cavity, is qualified, physiologically, for human tone-color speech, and intelligent animals of this kind can, it is well known, be trained to repeat words of the human language, as well as to imitate human whistling in various pitches.

verse foot resembles a musical bar, the verse line (stichos) the melody-air, or "motive"; a group of verse lines resemble a "melody," or a "Melos" in the Greek sense of the word. The verses, when sung, give rise to regularity and order in the world of tones. *From the linking together of a succession of tone intervals, and of rhythm, in the narrower and the wider sense of the word, the science of tones—that which we now call "Music"—was born. With its release from these bonds it dies as a science.*⁷

⁷ Aristoxenus long ago made very apt observations about spoken and song rhythm. He says, according to Westphal: "In declaimed poetry, we, to be sure, experience strongly the difference between the rise and fall (thesis and arsis) of the verse foot; but it is very difficult here, perhaps impossible, to assign a definite space of time to these two periods; we are satisfied if the period allows us to note a certain number of accents (ictus); how long or how briefly one dwells on the enunciation thereof does not concern us; we take the privilege, and see in it just the advantage of a well-expressed style of declaiming, of resting longer on such syllables, which are especially important for the logical sense, irrespective of the fact whether it is done by a longer-continuing enunciation or by pauses; and it is also a matter of indifference at what these pauses occur; whether at the end of the colon (verse foot) or within the colon and the verse foot. (One sees from this that already in the delivery of Greek poems that were not sung, particular attention was not always devoted to the length and shortness of syllables, upon which Greek metrics are founded. Note of Hanslick.)

"In music, however, the duration of the arses and theses are subject to a definite measure of time, and likewise the pauses occurring here are integral parts of the rhythm. By the symbols — ∪ we understand that the second syllable is half as long as the first, accordingly — ∪ =  or  They have no absolute value. (Except when they are determined by the metronome. Note of editor.) The values of the rhythm, assumed at the beginning of a piece, in music remain the same; in declamation, on the other hand, they may be changed at pleasure. In the rendition of songs, the change in time of the smallest parts of a bar (of the Chronos protos) has become almost the rule; it is just through this that this kind of vocal music approaches speech; but the musical rhythm must never be neglected to such an extent that it becomes incomprehensible to the listener. Herein much depends upon the art of the singer. The free instrumental 'performance of the melody of a song' rests upon the fact that it takes liberties, just like the singer, as if it desired to play words, and thereby often scores a great effect, and makes an impression very much as does a song. Exaggeration in a performance in this direction is in bad taste; it can easily become unmusical. The so-called phrasing must, in spite of all freedom, always be simple, clear and musical, and never leave the listener in doubt as to the kind of time. Liszt, Rubinstein and Joachim were and are masters in this kind of playing. Modern music, like that of Chopin, Schumann and others, permit of a performance that gives very much more the effect of words. In the music of Bach and Händel, as well as in that of Mozart, Brahms and R. Wagner this kind of playing has an absolutely bad effect. These composers treat the composed verses metrically and musically-rhythmically with as great a degree of correctness as modern taste permits, although by this I do not mean to say that they ought to be sung according to the metronome. Every composer ought to be treated according to his style. A sensible actor does not play and speak Shakespeare in the same way as he would Dumas. Similarly, a sensible singer sings Händel differently from Massenet. He who makes the mistake, in rendering the simplest song, of

Since one can find in every history of music the representative of the so-called old musical modes or tone-scales, from the Greeks down to the Middle Ages, and their physical explanations in the classic work of Helmholtz, I shall not go further into this subject and will only add that, in my opinion, these tone-scales were only determined after they had long been in common use. The musician composed (granting indeed that this word can be employed for the old recitative music), not according to fixed tone-scales, but constructed the tone-scales from the existing compositions, which persisted principally through tradition. But doubtless the development of the language, especially the pronunciation of the vowels, had a great influence upon these. We all know that with the same laryngeal tone (Kehlkopftone) we can pronounce the various vowels, that is, we can change the tone-color of the laryngeal tone by means of modifications of the oral cavity to such a degree that of the different tones of which the laryngeal tone is composed, now this, now that higher overtone or undertone is heard to resound predominantly in unison. If this were not so, or even if it were possible only to a certain degree, one could only speak and sing the deep-sounding vowels (U, O, Au) with deep laryngeal tones, the high vowels (Ae, E, Ue, I) only with high laryngeal tones. In fact it is difficult to produce the deep vowels on high tones and the high vowels on deep tones, but this can be done with practice.

According as certain pure or impure vowels predominate in a language or dialect, so must certain cadences become easier for the hearers or speakers. If one determines them according to their sound, by means of notes, and brings together the tones occurring at the various intervals according to their succession of pitch (Höhenfolge) within an octave, then one gets those tones, which are used, as a scale of tones following one another—a tone-scale. It is clear that such a tone-scale must result very differently, according to the language of the people concerned (Lydian, Doric, Ionic), indeed even according to the taste of the individual. The Italians did not cling to the tone-scales, as they had come down to them from the Greeks and Romans. The Jewish Christians

laying pointed emphasis on every word and verse of the poem—effectively for the mass of a concert audience as he imagines, that is, for the unmusical or the slightly musical—often produces a musical caricature. He who performs purely musically, without much reference to the text, can give much enjoyment to the musical connoisseurs, in his singing of an aria of Händel or Mozart, but the vast majority of the audience will be entirely unresponsive, the more so, if he emphasizes or tries to emphasize also in singing songs only that which is the purely musical. To keep the true mean depends on the character of the singer, which may be somewhat changed, that is, restrained or stimulated by frequent hearing of other singers, and also by a good music teacher. But one soon learns to recognize that which has been acquired, and finally the character of the singer will reassert itself. It is given to but few to quickly find the musically correct for the largest portion of the audience, wherein the personality of the singer has a large share of the success. In a dark concert hall the judgment would be very different; the public wants to see, and especially *see itself.*"

added new changes, so that new tone-scales kept arising, which finally were not even determined any more. The popes, Gregory the Great and Sylvester, tried to fix again the old tone-scales for Church music, as well as to determine a few newer tone-scales. Many improvements in the notation of the intervals also arose, the symbols being placed on and between lines, instead of the books previously used. But all this did not satisfy the need for the so-called harmonious singing together, which in those days sounded pleasant; and again, the learning of the many tone-scales was very complicated. It took centuries after the introduction, by Guido d'Arezzo in 1050, of the principles of the present notation before a process was completed by which the present chromatic scale was finally developed from the old tone-scales. From this scale two tone-scales were selected which contained seven tone-intervals within the octave, and which differed from each other only by the fact that either the small or the great third (minor or major) was employed. Besides, this scale, which was composed simply of whole and half tones, in definite succession, could start from any desired one of the twelve half-tones lying within the octave; the difference consisting only in the key note (Ausgangston). All our harmony and melody rest on this system. Who discovered it? It certainly was not invented by one man, and forcibly imposed—the pope himself could not do that! It has developed out of practical need, out of convention (in the previously determined use of the term). For its determination, to be sure, experienced musicians were necessary; a certain fixed definite symbol was needed for each single tone; definite names had to be found for the modes, that is for the keynotes of the scales, definite names for raising and lowering tones, and so forth. History tells of no actual inventor of our present system of music; it has existed only for a little more than two centuries.

I mean that our present system of music, into which we are born, and which we can only with the aid of historical study imagine to be different, has developed just as gradually as our language. Luther did not invent the New High German in his Bible translation (it arose as a compromise between the South German and the Lower German or Platt-deutsch), nor did he force it upon the German nation; but he fixed it as the written language in the most important and most popular book of his time, and this language, greatly enriched by Goethe and Schiller with South German words and phrases, will presently absorb all the dialects, one after the other, simply because it is fixed; it does not on this account remain rigid, but is always absorbing new words and phrases, both from these dialects and foreign tongues, not from any intentional violence (Vergewaltigung) on the part of single writers, but from a certain ever-existing need for more exact terms to describe old and new qualities and occurrences, as well as from a need for variation in sound. We can as little imagine that our present system of tones will change as we can imagine any essential variation in our language. Music without rhythm, without melody and harmony, without a certain conventional regularity, would no

longer be for our impressions music, but a concatenation of crying, howling, raging, weeping, groaning, and rejoicing—in the form of shorter or longer interjections. It would be analogous to a relapse from the present imposing regularity to a savage condition, to individualism, to anarchy, to nihilism. Language, like music, is also a work of art; it cannot even be thought without a conventional arrangement of sentences, without a definite regularity of succession and order of the ideas that are to be expressed.

I have adduced all this to support my opinion that our modern music with its development of harmony and melody, and which, as it would seem, could only have reached its present elevation in our modern system of tones, did not develop according to anatomical-physiological laws of nature, and cannot be continued in the mathematico-physical formulas of a Laplace-like genius (Du Bois-Reymond), but arose from individual sensations and impressions and the needs of society and civilization, which, to be sure, have their origin in the important psycho-physical qualities of man and of human society. The physical representations of conditions for our present theory of harmony cannot claim to be more than mathematical attempts to explain the combinations of tones which have already been instinctively found and which affect us pleasantly (consonant) or unpleasantly (dissonant). The uncertain part of this lies in the fact that "pleasant" and "unpleasant" are just as variable qualities of sensations at different times and for different persons as, for instance, are good and bad. As it is, I cannot imagine that the sound of a major third, and still less that of a minor third, should ever have been considered an unpleasant discord (a dissonance), although many centuries ago it may possibly have had that effect on the people of that time, and as regards the number of violations of the upper partials (Schwingungsverhältnisse) expressed in numbers it ought to be so. In art, as a rule, "Whatever pleases is allowable," particularly to those who take an especial delight in the art and make it their own by means of study and practice.

As to the difference of major and minor keys, we at present usually connect with them conventionally the ideas "joyful" and "sad," having in mind, perhaps, the literal meaning of the terms themselves, "hard" (dur) and "soft" (moll). It has always seemed to me that the older dance music and love songs of the French and other civilized nations were generally in a minor key. The minor keys also seem to me to predominate in the folk-songs of the half-civilized Slav and Hungarian nations, although they are also used for dancing; they also occur in the monotonous songs of Oriental nations. Others have already made the same observations. This has been interpreted to mean that all uncultured nations have a melancholy temperament; that the major key is the "natural" one, partly on account of the rhythmic relations of the fundamental tones, partly on account of the unconsciously heard overtones, which make the major chord. I think this explanation is incorrect. My opinion is that it is easier and requires less exertion of the laryngeal muscles to sing the minor third or sixth than the major; even the

trained singer will admit this. Most persons talk in the minor key, and sing or scream in a major key. In all languages (the monosyllabic ones excepted), the last syllable usually drops into a minor key. When a people begins to sing, it naturally knows nothing about a scale of tones, or a mode (key). But the succession of tones of the existing song recitations must have led principally to a minor key, when tone-scales began to be fixed. Every person speaks usually in one key; in ordinary conversation I speak in D minor, in singing in D major. If I lie quietly on my back and without exertion sing a scale upwards, the following are most convenient for me as a bass-singer: D, E, F, G, A, B, C (Doric); the same hold good when going down the scale. In singing tones which on account of their height require exertion, a little more exertion does not matter; major and minor are, when high, alike in this respect. If therefore the development of the modern chromatic scale is based more on social and conventional causes, the development of major and minor and especially the latter's predominance in the beginnings of music apparently, seems to me to have more purely physiological reasons, namely, the lesser exertion of the laryngeal muscles and the relation to the cadence of words.

The development of arts and sciences, like every development, and every construction, does not proceed by leaps and bounds; every addition, every advance, is linked with something that has gone before. After the chord of three sounds was once felt by many to be one of the most agreeable of harmonies, and accepted as such, the rest developed from it in a tolerably logical order. A mathematical proof that only this triad could please, and that it alone could serve as the conclusion of a system of harmony, cannot be adduced. We can only say that man in the course of his cultural development has developed a pleasure in certain regular relations. This holds true especially for architecture, and here, to be sure, was dependent on purely physical relations, on the empirically found laws of statics. Later that which was originally necessary and useful in the relations of construction became gradually the customary, the agreeable, the beautiful. But there is a great difference between visual and auditory perceptions, and it is a bold idea to think that our organ of hearing measures the agreeable in a consonance of sounds according to the physical causes of its intervals, for instance, the intervals of the octave, as the eye measures an edifice with a standard of length. I cannot grant to acoustics such an unconditionally fundamental importance for the development of music as I accord to statics for architecture; for every combination of tones is possible, but not every kind of combination of building material. I could hardly imagine what one could urge physically and psycho-physiologically against anybody who might claim that for him the combination of C, C sharp, D, or C, D, E, or C, C sharp, D sharp, was most agreeable and was harmony, while on the contrary a triad was very disagreeable. It is only a question, how large a public there is which also feels, or claims to feel this, and which hears pieces composed on the basis of these tone-combinations, which to it are agreeable, with increasing and

continually spreading enthusiasm: one cannot furnish a proof that such a music is absolutely impossible and not beautiful. The majority of the public carries the day, and when it is tired of this kind of music, will follow others who offer something else. An analogy may be found in the formation of a sect, which results from the impressions and broodings of a single person, but becomes a wide-spread religion only by the number of those who join it. The impression of the one is, to be sure, a part impression of the whole (*Teilempfindung des Ganzen*) in a particular form; but why just this form in which it appears should especially please few or many of its contemporaries, cannot be demonstrated either mathematico-physically or psycho-physiologically.

I must finally express my conviction that *the sensation of that which is harmonic is conventional, that it gradually developed in the subject, and is not originally necessary.*^{*}

The same holds good for what we now call music. I would not think of maintaining that, before the introduction of the diatonic and chromatic scales there could not have existed any harmony and melody partially agreeable for us. Both of these words are derived from the Greek and already at the time of their first use denoted certain combinations and successions of tones which were agreeable to the ear. It is probably doubtful, however, if we should experience as a pleasant succession of sounds at the present day, all that which the Greeks called melodious (from *melos*, song). The same holds true of the music of the Middle Ages. Indeed, many of the Protestant chorals, fixed by Luther, intended to be sung by the congregation, and often taken from worldly folk-songs, now hardly give us a melodious impression, nor do the words strike us as poetical. The memory of childhood and of the impressions which the Protestant order of worship made upon the youthful mind, is necessary for a warm appreciation of many of these chorals. As it is, a

^{*} An ear-witness (Wittmans, in the "Neue freie Presse") gives the following report of Chinese theater music: "The star, dressed like a prima donna, sings an aria. This indeed is almost more than a European ear can stand. We simply cannot imagine how they can call such a maiming of the voice (*Stimmverquetschung*) singing. It is in this way that a raven croaks, a cat meows, a door creaks on its hinges, a dry boot-sole squeaks, a pig squeals, a wheel screeches under the brake; thus the Easter rattle of the street gamin resounds, but no human being ever sings in this way. The orchestra, besides, very seldom stops. The representation is almost continuously accompanied melodramatically. Higher dramatic movements are naturally treated more in detail, especially those of battle and conflict. The cymbals whirl, the tom-tom resounds, the whistles scream, the fiddles moan, and all is raging topsy-turvy, and over all the terrible kettle-drum rattles as if madness were wielding the hammer. Not a trace of harmonic combination. Here the genius of discord conspires with all evil music-hating fairies to call into existence a symphony of horrible noises of which we can simply form no conception." The Chinese are the oldest civilized nation, and take the same delight in their music as we in ours. Who is right? Both; we can here form no compromise. Our reporter adds: "In the living presence it (the theater) gives the impression of a senile art that has become childish." Will this also be the end of our theater, of our art?

Catholic would find it hard to accustom himself to the singing in common of all the congregation, just as a Protestant would not appreciate the mass, and the music of masses. Whoever seeks the opportunity of developing himself musically, must live into both these forms of Christian church-music, and will be able to find the melodious in both; it nevertheless requires a sort of historical self-adjustment. What now does the term "Melody" denote for us? One is accustomed to say: "A rhythmically formed succession of tones, which is agreeable to the ear." In general there is no objection to this, and we will now go into the matter a little more deeply.

I have previously pointed out that music developed into a "science of tones" chiefly because it connected itself with such word-thoughts (Wortgedanken) as were rhythmically formed in verses; by this it was bound to a certain form of rhythmic repetition. If one sang the music without words, or played it on an instrument, then one had a rhythmically ordered succession of tones, a "melody," which probably still bore the traces of speech cadence, but could exist by itself. Thus arose the regular, absolute music, music without words. I heard in Grosswardein, if I am not mistaken, several czardas, which pleased me very much, played by a somewhat civilized gypsy orchestra; when I found out that they were composed by the first violinist, I asked him if he had had them printed; he answered: "Not yet, I must first look for words for them." Witty persons among the populace not infrequently make new verses for existing well-known dance tunes of a definite rhythm; the improvised quatrains call forth the same enjoyment among the people that improvised couplets do among the audience of a theater. Thus at one time the music comes first, at another the words; that in the beginning, however, the words formed the point of crystallization for the music is my opinion. That the successions of tones, which were rhythmically joined on account of the words and verses, might separate themselves from the words, and gradually become forms which sounded independently of the words and were differently connected, is just as comprehensible as the fact that, later on, new speech-rhythms developed without reference to tones. The forms of the science of tones, when separated from the words, gradually attained a certain degree of independence, and found the *new condition of their development in the new material*. Thus independent instrumental music arose. Its derivation from church music, march music, dance music and work songs, can be plainly recognized in the forms of our modern instrumental music. The suites of Bach are composed of the melodies of dance music: courante, sarabande, pascaglia, gavotte, minuet, gigue. The minuet has maintained its position in sonatas and symphonies down to the present day. Marches, and especially funeral marches, still occur in serious concert music. The rhythms of riding songs, traveling songs, thrashing songs, anvil songs (Schmiede Lieder), sailor songs (when heaving the anchor), spinning songs, harvesting songs, etc., have been derived from the rhythmic movements of the body and are arranged for them. If, indeed, they have not been used for

purely instrumental music in exact song form, they have enriched it by means of their various rhythms. Since language is one of the prime factors which affects musical rhythm, it follows that international intercourse, which brought us more frequently into communication with the languages and popular music of other nations, has enriched international music with very many new rhythms; it (music) has taken up the rhythm of the national English, Scandinavian, Italian, Slavic, Hungarian dance-songs and dances.

It will probably be universally admitted that we can conceive of a "melody" only as a rhythmically ordered succession of tones, and that this rhythm arises from different sources. But the above definition of "melody" requires also a succession of tones *pleasant* to the ear. One at once asks: "Pleasant to what ear?" If one answers somewhat like this: "To a musical ear," the question at once arises: "What are the characteristic signs of a musical ear?" We thus get into a circle of questions, from which I find no exit. We do not inquire about rhythm, whether it is unpleasant or pleasant; the most one can say is that a quick rhythmic motion can be disagreeable for us, if we are in a contemplative, quiet mood; it disturbs us or tires us on account of accompanying it, and the like; but a rhythm as such, independent of our moods, does not easily arouse an impression of the beautiful or the ugly. It is different with successions of tones. The series C', F' sharp, B', F'', and also C, C sharp, F' sharp, B, give me an unpleasant impression; why? because so pronounced an after-sound (Nachklang) remains in my ear when these tones do not follow one another too quickly, that I experience all four sounds as a combination of sounds, and this combination displeases me. Here, again, we may come back to harmony. In the popular, conventional term of modern music, a tone series seems pleasant, if it moves within the harmonies to which we are accustomed and which therefore have become agreeable to us. Thus we conclude that melody and harmony are most intimately connected. If one recalls any melody that has become popular, one finds it moves within easily scanned, not too variable harmonies and successions of harmonies, which have become customary to us (conventional), and that it finally returns to the key from which it started. This, indeed, constitutes what we usually call the melodious. The number of persons who are sufficiently musical that they can not only sing simple songs together but can also be taught songs in parts, is uncommonly large in the German nation. German-Austrians are especially distinguished in this respect. At St. Gilgen near Salzburg, on the banks of the beautiful Aber lake, where I usually make my summer abode, they have a small chorus and a small wind orchestra; the people take the greatest delight in singing and playing together, and practice new pieces every winter. And yet the village has but twelve hundred inhabitants. Naturally one must not criticise these performances too severely; but the pleasure to be derived from music is sufficient to pay for some little trouble to obtain it. The music of the mass, in which such of the children and grown persons as are suited for it are trained by the

organist and schoolmaster, gives more scope for church music than the singing in unison of the chorals in the Protestant order of worship. The Catholic service also has a powerful effect on the imagination, inasmuch as it draws to its aid music, painting and colored sculptures (for the statues of the Madonna, Christ and the saints are always painted). Hence also are derived influences which permeate the everyday life of the people.

The connection of the rhythmic and the harmonic is probably generally recognized; indeed, to some extent, it is always assumed. Similarly the desire and the striving to multiply the succession of harmonies is intimately connected with the same wish in regard to melody, and this holds good just as far for rhythm as for the succession of tones. The music which we have discussed previously is usually termed popular, because it readily spreads through large masses of society. But this does not satisfy those who feel the need of much music, and who from an innate disposition always think of music, and from inner compulsion must always busy themselves with it. Even in church music, not only as regarded the choir, but also the individual singers, there arose the desire for change, for something new. Men became wearied not only by the successions of harmonies, which finally became tiresome from eternal repetition, but also by the melodies, which always proceeded at the same rate and changed but little in rhythm, and which were originally sung by the tenor, then possibly also by the bass, and finally almost exclusively by all in harmony. Attempts were made to have the voices not always commence and finish at the same time, but to enter gradually, and to let some cease occasionally. Again, the rhythms were divided into smaller parts or enlarged, without bringing about any interruption in the harmony. The latter change led to the so-called polyphony. Each single voice went its own way without disturbing the harmony of the whole; in order to preserve the unity of whole, they came together from time to time, and necessarily, of course, at the end. Thus arose the canon, fugue and other tone forms; music had gained the mastery over words. The new method became popular and underwent further and further extension. The rhythmic element (rhythmic motive), from which polyphony arose, for a while aroused more interest than the harmonic and melodious, indeed such exclusive attention was devoted to it that the harmonic was somewhat neglected, attention being mainly directed to the individual voices. So heedlessly did the composers proceed in this direction that music became more difficult to execute and more removed from the popular style, so that to a certain degree it represented even its antithesis. This led to a return to the predominantly harmonic and melodious. Naturally, in the excessive development of polyphony, the words and the total expression (*Gesamtausdruck*) of the word-thoughts suffered; the excessive and continuous polyphonic treatment of the voices no longer corresponded to the state of mind which was meant to be called forth by the words. This conflict between music and the words, as well as between polyphony and harmonic melody has already lasted for sev-

eral centuries in the history of music. Hardly had certain concessions been made on each side when both the artist and the public wearied of them, and diverged again until new compromises were once more reached. Since the connection of word-thoughts and tone-expressions (*Tongestaltungen*) has no natural physical basis, but is purely conventional, this hesitation, how far we should favor the one or the other perception in their simultaneous action (the hearing of the words and thoughts or the hearing of the tones and tone series) will last as long as man speaks and sings at all. Language has developed its own forms for the expression of thoughts and impressions, for the purpose of poetical expression, according to certain conditions inherent in itself. Tone expressions have separated from the words and from song and have also developed into certain forms, into the science of tones, according to certain conditions which exist in the world of tones (*Tonwelt*). Nevertheless, the conditions under which the greatest effect of poetry and the greatest effect of music are developed are only partially the same; often they heighten each other, not infrequently they stand in complete contrast.

Turning our attention from the connection between tones and words, we may now glance at the development of instrumental music—the so-called absolute music. I can easily imagine that in times past the instrumentalists found it wearisome to always continue with the same rhythm in the conventional harmonies. Each one, therefore, began to make various changes for his own entertainment. So long as only one took this liberty, the innovation could serve to interrupt the monotony very pleasantly. If, however, every quartetist in every bar allowed himself such changes as suited him, in comparison with the conventional harmonic, the general effect would very often be bad. This tendency toward variation in the performance of quartets and symphonies probably lasted longest among the Italians. Thus Spohr in his autobiography* speaks with horror of the variations which even the horn players and clarinetists allowed themselves in the accompaniment to one of his violin concerts at Rome. When not carried beyond moderation, however, variation also pleased the greater public, and the composers soon introduced more movement and a regular polyphony into their instrumental works. But the separation of music from words had still another result for the development of instrumental music. The melody was no longer bound to the order of words—it could, therefore, be used also piece-meal, and could be separated into single “motives” (*Bewegungsmomente*), which could then be utilized more freely; one could put the motives taken from the melodies alongside, over or under each other, and play with them at will harmonically and rhythmically. Indeed, melody in the former coherent form was no longer used; one could work nicely with shorter or longer motives, and then for a change bring in again a finished melody, and so forth. Thus new tone forms arose, based on a purely musical foundation, among which the so-

* Vol. I, p. 330.

called sonata form soon gained the upper hand. From Scarlatti and Emanuel Bach down to Brahms it has been developed in many ways. Its essence consists in the change of rhythmic and harmonic motives, in partly predominantly polyphone, partly predominantly melodious development of tone forms. The rich diversity developed in this way in the hands of eminent composers has been striking; besides the sonata forms or even within them the harmonic variation of complete melodies—of a so-called theme—has been developed. One can, to be sure, call this playing with motives, and especially as regards the so-called development in the sonata form, a variation of the same, but this is not so strictly bound to a definitely formed theme. This development of purely musical forms, however, had a strange effect on that which we usually call melody. In polyphone music the attention is so much taken up in the pursuit of the rhythmic movement of the single voices, by the motives, which move away from each other, toward each other, over each other, that the discords which arise in passing are not heard, provided only that harmony sets in again at certain rhythmically important points. We can endure a considerable amount of dissonance, even long continued, provided only we feel in advance, by means of our impressions which are accustomed to the usual succession of harmonies, that consonance must soon set in. As a good instance the long trill on the seventh at the end of the *Athalie* overture by Mendelssohn may be taken. *The phenomenon that we principally and consciously perceive that upon which we concentrate our whole attention, leaving all else observed physiologically at the same time unnoticed*, is widely extended in the domain of sense-perceptions. Thus most persons have a number of opaque little points in the vitreous humor of the eye, which they do not notice so long as they look at objects and direct their glances at them, whereas they at once perceive them as so-called “*mouches volantes*,” as soon as they unconsciously look in the distance; similarly the after-images in the complementary colors do not disturb us because we do not notice them. The same, however, takes place in purely psychical phenomena. *It is an essential characteristic of the civilized man*, which must be acquired from childhood, to direct, to concentrate the attention, the “inner aspect” upon some few concepts, whether they arise directly or are reproduced.

We have previously admitted that the “melodious” consists essentially in the fact that the tone series takes place within accustomed harmonies which do not change too frequently. This conception, however, becomes much more enlarged for the musically educated; he gets accustomed not only to pass over transient discords, but even to feel them to be agreeable or at least “interesting,” provided that at the same time he can clearly perceive the most important lines along which the tone masses proceed. If we hear only firm, strong bass notes, and retain them to a certain extent as a melody or theme, it does not matter if we hear at the same time rising or falling diatonic or chromatic scales. Indeed, even series of harmonies existing strong and firm can be made more interesting for us by parallel scales; we do not notice

the momentary passing of horrible discords. Take, for example, the introduction to Mozart’s “*Don Juan*” overture. If we designate these scales as a melody, probably no objection can be made, although there is a tradition that Mozart inserted them in the score later on. Chromatic tone series occur so often in melodies and motives, from Bach on to Brahms and Wagner, that we have grown completely accustomed to them; we transfer the rhythmic movement of the tone series (that which one calls in painting the lines or outlines) to the inner point of hearing (physical and psychical) and do not notice that which resounds at the same time.

It would not be very difficult for a good composer to make an interesting musical motive out of the tone series which, as I said before, sound disagreeable to me—the tone series Bach (b, a, c, h) and Aecb (a, e flat, c b) out of which Liszt and Schumann made fugues, do not sound much prettier when heard for the first time—yet after becoming used to them by frequent repetition, one may consider them melodies.¹⁰

As long as the appearance of transient discords does not pass beyond a certain limit, it entertains and interests us; for that which we conventionally are accustomed to experience as harmonious wearies us, if its effects are continuous and unchanged. But where is this limit of the interesting? How long can we endure the discords and complication of rhythm without having our enjoyment lessened? This cannot be determined, inasmuch as here we have to deal with purely individual, and up to a certain degree, social factors of sensation (*Empfindungsmomenten*, esthetic motives). Much always depends upon how many follow, as disciples of

¹⁰ On the piano, inasmuch as it is difficult to distinguish the various voices of a polyphonic piece on account of the weak sounding (*Fortklingen*) of tones that are held, and also on account of the same tone timbre of the instrument, harmonic harshnesses are especially emphasized. To play fugues for the piano is very interesting; to simply listen to them affords very problematic enjoyment; the same holds true of other polyphonic music written for the piano, especially of complicated musical compositions arranged for four hands. Well rehearsed polyphonic orchestral and choral music is much easier to understand, because the single voices stand forth better on account of the difference of the tone colors of the various instruments and voices. The fact that difficult music (*schwierig zu bewältigende*), especially a string quartet, sounds perfectly horrible when played by otherwise practiced dilettanti, is principally due to the uncertainty and timidity with which the tones are sounded and the bow is moved. Therefrom arise so many uncertainties, and so much scratching and scraping is heard alongside of the tones, that much good will and endurance are required to listen to new and complicated music under such conditions. On the piano one plays either correctly or incorrectly; in string music (and also in wind music), there are so many shades of incorrectness which we designate as impurities, that the hearer often does not know what he is hearing, and how it really ought to be. I must also confess that I have seldom heard string quartets, even those composed of the best artists, which at the beginning of a concert sounded absolutely clear to me. Does it depend on the performers or on the fact that the ear in a large room must first accustom itself to the combination of sound from the four string instruments, which is most beautiful in itself?

a so-called new style of composition, that new composer who predominantly pursues the interesting. If he has really found the direction toward which the soul of the musical, or indeed of the unmusical people was striving, then he will gradually find more and more disciples; if he has not found this direction, they will let him go by himself and laugh at him.

Helmholtz expresses that which we have developed in this section in our own fashion, in the following manner, in his classical book:¹¹ "The amount of harshness which a hearer is inclined to endure as a means of musical expression, depends on his taste and his habits; therefore the boundary between harmony and discord has often undergone changes. In the same manner tone-scales, tone-modes and their modulations have been subject to manifold changes, not only among uncultured and rude peoples but even in those periods of universal history and among those nations, in which the most perfect flowers (Blüthen) of human culture were developed (zum Aufbruch kamen)."

From this follows the conclusion, which is not yet sufficiently impressed upon the minds of our musical theorists and historians, that *the system of tone-scales, of tone-modes, and of the harmonious interweaving of the same does not rest upon immutable laws of nature, but is the result of esthetic principles, which in the progressive development of humanity are subject to change, and will continue to be so in the future.*

CONCLUSIONS.

In expressing my personal impressions on Billroth's contribution to the psycho-physiology of music, I may say that it is an admirable attempt and largely a successful one, to blend and harmonize the esthetic aspects of music on the one hand, with the physiologic and physical aspect on the other. That this is a task of exceptional difficulty is proved by the fact that few successful writers on this subject have emanated from the German nation. Helmholtz in his "Sensations of Tone" has emphasized this difficulty. He holds¹² that it is a mistake to make the theory of consonants the essential foundation of the theory of music and insists that the essential basis of music is melody. This is at the outset a confession which affords great comfort to the esthetic worshipers of music. The life and essence of music, therefore, do not depend upon physical, mathematical or physiological facts, but upon melody—a psychological entity. Helmholtz in his well-known work, incurred the enmity of two classes of critics, those of an esthetic or psychological bent, and those of a physical or mathematical leaning. The same experience would have fallen to the lot of Billroth had he lived to see the publication of his book; the fact that the volume was not printed until after his death modified the fierceness of the critics. Nevertheless, a few of them have brought forward the same objections that Helmholtz' work aroused. The Latin proverb *Mortuo leoni et lepores insultant*,

(Even hares can insult a dead lion), applies to these critics, but perhaps the best answer to them is found in the work of Helmholtz just quoted: "Harmony has become to Western Europeans during the last three centuries an essential, and, to our present taste, indispensable means of strengthening melodic relations, but finely developed music existed for thousands of years and still exists in ultra-European nations, without any harmony at all. And to my metaphysico-esthetical opponents I must reply, that I cannot think I have undervalued the artistic emotions of the human mind in the Theory of Melodic Construction, by endeavoring to establish the physiological facts on which esthetic feeling is based. But to those who think I have not gone far enough in my physical explanations, I answer, that in the first place a natural philosopher is never bound to construct systems about everything he knows and does not know; and secondly, that I should consider a theory, which claimed to have shown that all the laws of modern Thorough Bass were natural necessities, to stand condemned as having proved too much."

It is true that acoustics constantly employs conceptions and names borrowed from the theory of harmony, and speaks of the "scale," "intervals," "consonances," and so forth; similarly, manuals of Thorough Bass generally begin with a physical chapter which speaks of "the numbers of vibrations," and fixes their "ratios" for the different intervals. But, up to the present time, this apparent connection of acoustics and music has been wholly external, and may be regarded rather as an expression given to the feeling that such a connection must exist, than to its actual formulation. Physical knowledge may indeed have been useful for musical-instrument makers, but for the development and foundation of the theory of harmony it has hitherto been totally barren. And yet the essential facts, within the field here to be explained and turned to account, have been known from the earliest times. There is good evidence for believing that Pythagoras (B. C. 540-510) knew that when strings of different length, but of the same make and subjected to the same tension, were used to give the perfect consonances of the Octave, Fifth, or Fourth, their lengths must be in the ratios of 1 to 2, 2 to 3, or 3 to 4 respectively, and if, as is probable, his knowledge was partly derived from the Egyptian priests, it is impossible to conjecture in what remote antiquity this law was first known.

Concerning the limits of the purely psychical ("rein Psychische") in the perception and interpretation of Music Helmholtz (l. c.) admits that: "Musical esthetics has made unmistakable advances in those points which depend for their solution rather on psychological feeling than on the action of the senses, by introducing the conception of movement in the examination of musical works of art. E. Hanslick, in his book 'On the Beautiful in Music' triumphantly attacked the false standpoint of exaggerated sentimentality, from which it was fashionable to theorize on music, and referred the critic to the simple elements of melodic movement. The esthetic relations for the structure of musical compositions, and the characteristic differences of individual forms of composition,

¹¹ First edition, p. 358.

¹² Translation by Alex. J. Ellis, Preface, page vii.

are explained more fully in Vischer's 'Esthetics' (Aesthetik). In the inorganic world the kind of motion we see reveals the kind of moving force in action, and as the only final method of recognizing and measuring the elementary powers of nature consists in determining the motions they generate, so it is also for the motions of bodies or of voices which take place under the influence of human feelings. Hence the properties of musical movements which possess a graceful, dallying, heavy, forced, dull, powerful, quiet, or excited character, and so on, chiefly depend on psychological action. In the same way questions relating to the equilibrium of the separate parts of a musical composition, to their development from one another and their connection as one clearly intelligent whole, bear a close analogy to similar questions in architecture. But all such investigations, however fertile they may have been, cannot have been otherwise than imperfect and uncertain, so long as they were without their proper origin and foundation, that is, so long as there was no scientific foundation for their elementary rules relating to the construction of scales, chords, keys and modes, in short, to all that is usually contained in works on 'Thorough Bass.' In this elementary region we have to deal not merely with unfettered artistic inventions, but with the natural power of immediate sensation. Music stands in a much closer connection with pure sensation than any of the other arts. The latter deal rather with what the senses apprehend, that is with the images of outward objects, psychical processes collected from immediate sensation. Poetry aims most distinctly of all at merely exciting the formation of images, by addressing itself especially to imagination and memory, and it is only by subordinate auxiliaries of a more musical kind, such as rhythm, and imitations of sounds, that it appeals to the immediate sensation of hearing. Hence its effects depend mainly on psychical action. The plastic arts, although they make use of the sensation of sight, address the eye almost in the same way as poetry addresses the ear. Their main purpose is to excite in us the image of an external object of determinate form and color. The spectator is essentially intended to interest himself in this image, and enjoy its beauty; not to dwell upon the means by which it was created. It must at least be allowed that the pleasure of a connoisseur or virtuoso in the constructive art shown in a statue or a picture, is not an essential element of artistic enjoyment.

No doubt the ultra physical psychologist would have been more pleased if Billroth had succeeded in localizing a circumscribed area of the cerebral cortex and given experimental and pathological evidence that it was the center for musical apperception, as Broca did for the centre of speech.

But when we are guided into the understanding of the true nature of musical apperception the difficulties in the way

towards such an anatomical basis for a cortical musical centre become evident.

The sensation and consciousness of music after all that has been said is something more than "*a psychic process collected from immediate sensation.*" The relation of musical apperception to the sense of hearing is something more intimately psychical than the relation of the senses to the functions of their anatomical end organs (*e. g.*, of the sense of sight to the eye or rather to the retina).

To utilize the comparison of Helmholtz in the introduction to his *Sensations of Tone*.

"It is only in painting that we find color as an element which is directly appreciated by sensation, without any intervening act of the intellect. On the contrary, in music, the sensations of tone are the material of the art. So far as these sensations are excited in music, we do not create out of them any images of external objects or actions. Again, when in hearing a concerto we recognize one tone as produced by a violin and another by a clarinet, our artistic enjoyment does not depend upon our conception of a violin or clarinet, but solely on our hearing of the tones they produce, whereas the artistic enjoyment resulting from looking at a marble statue does not depend on the white light which it reflects into the eye, but upon the mental image of the beautiful human form which it calls up. In this sense it is clear that music has a more immediate connection with pure sensation than any other of the fine arts, and, consequently, that the theory of the sensations of hearing is destined to play a much more important part in musical esthetics, than, for example, the theory of perspective in painting. Those theories are certainly useful to the artist, as means for attaining the most perfect representation of nature, but they have no part in the artistic effect of his work. In music, on the other hand, no such perfect representation of nature is aimed at; tones and the sensation of tone exist for themselves alone, and produce their effects independently of anything behind them."

Although no such contribution to localization as that of Broca has been made by Billroth in his psycho-physiological aphorisms on music, nevertheless his work will prove of value because of the general clearing of the entire subject of physical and physiological acoustics and by rendering the work of Helmholtz more accessible and more intelligible to musical artists and connoisseurs so that they may hereafter become conversant with the scientific aspect of their art. Above all, by pointing out the gaps and breaks in the experimental and practical logic he has emphasized the gaps that must be filled before we may hope to reach more tangible results concerning the purely psychological aspects of music.

THE JOHNS HOPKINS HOSPITAL BULLETIN.

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REPORT ON THE EXAMINATION OF THE EARS OF 440 SCHOOL CHILDREN.

BY H. O. REIK, M. D.,

Assistant in Ophthalmology and Otology, The Johns Hopkins University, and Surgeon to the Baltimore Eye, Ear and Throat Charity Hospital.

In November, 1899, I was asked by the principal of a large school in Maryland to take part in an anthropologic investigation which he had instituted among his pupils. My portion of the work was to consist in an examination of the ears, primarily for the purpose of determining the number having defective hearing, and, secondarily, to make measurements of and note defects about the auricle. The general body measurements were made by the director of physical culture, the eyes were examined by an ophthalmologist, the teeth by a dentist, and I incidentally examined the nose and throat because of the frequency with which ear troubles originate in these organs. All of the work was done with considerable care, and I anticipate a complete report from the school which will be of interest to all who are concerned in the management of schools or the general advancement of improved educational methods.

In the report which I am about to present I shall confine my remarks almost entirely to the otologic investigation which proved of great interest to me, of considerable value to some of the pupils, and which, I trust, will be applied to other schools in the future. We all realize the great benefits resulting to the children from the eye examinations conducted in our public schools during the past few years, but up to the present time we have not given the ear its proper consideration. It is almost, if not quite, as important an organ as the eye and the fact that it is not so frequently diseased and that a slight defect, which may be the beginning of serious trouble, is not so readily detected at an early stage by the child or its guardians renders it all the more imperative that it should receive the same watchful care we have inaugurated for the protection of the eye.

The method which I employed in making this examination was quite simple and yet fairly complete. A large room in a quiet portion of the school building was placed at my disposal and a schedule prepared assigning the pupils to definite appointments with me at stated times. With the aid of a small alcohol stove a pan of water was kept constantly boiling and aural and nasal specula, tongue-depressors, etc., were sterilized in every instance before using. The accompanying blanks were used in recording the findings of examination. They were prepared in accordance with my own suggestion and served their purpose fully. Blank A is somewhat more elaborate, in regard to the hearing tests, than would be required in an ordinary examination of school children. Blank B is merely a letter to the parents or guardians of the child, and blank C it will be noticed was prepared solely for scientific purposes and contains nothing that would be of practical value in ordinary school work. After recording the name, age, sex, and the history of any previous trouble with

the ears, the external auditory canal and tympanic membranes were examined for evidences of any present or past trouble. Anterior rhinoscopy only was employed in examining the nares, and in looking at the pharynx no instrument was introduced into the mouth except a tongue-depressor. It was thought best to make this part of the examination as simple as possible and submit to its being incomplete, and in a few instances somewhat unsatisfactory, rather than risk any objections from the children or their parents. The tests of hearing were made with as much accuracy as possible without special and elaborate preparation.

I am not at liberty at present to name the school at which this investigation has been conducted, but I may say it is located in one of the largest counties of the State, in a healthy prosperous community which might serve as a good index of the general conditions in this State and the children were in every way a fair average of the children attending Maryland public schools, or, I think I might even say American public schools.

The total number of children examined was 440 and their ages ranged from 3 to 21 years, most of them—378—being between 7 and 17 years old (see table No. 1).

The hearing tests used, as shown by blank A, detected a deficiency of hearing in 45 or almost exactly 10% of the entire number examined. In 13 of these, however, the defect was due simply to accumulation of cerumen in the external auditory canal and could be easily remedied. In the remaining 32 instances the faulty hearing was the result either of former disease of the ear or of present abnormal conditions of the ear, nose or throat which would require the attention of physicians accustomed to deal especially with those organs. Thus, there were 2 cases of chronic otorrhœa; 6 of troublesome adenoid growth in the naso-pharynx; 7 of catarrhal otitis media; 1 obstructed Eustachian tube; 8 showed scar tissue in the tympanic membrane, the result of former inflammatory trouble; 14 had hypertrophied tonsils, and in some of these there was probably also some adenoid growth. Of the purely nasal affections noted there were 13 children with hypertrophied inferior turbinates; 5 deflected septa and 2 nasal spurs. In addition to these, 1 case of bifid uvula and 1 very markedly cleft palate were noted. Of course, a defect of hearing did not invariably accompany an abnormality of the throat or nose, but changes in these organs were recorded whenever they were of sufficient degree to require attention. In the majority of the 45 cases referred to, the loss of hearing was only slight and the prospects of partial or complete restoration under proper treatment would be good.

Here I desire to consider briefly one point which forced itself upon my attention during these examinations, namely:

the normal limit of hearing for high tones. Dench in his work on Diseases of the Ear states that "The normal ear perceives vibrations as musical notes repeated at regular intervals from 16 v. s. to about 32,500 v. s.," and these points "may be called the lower and upper limits of audition respectively." This statement is perhaps generally accepted in so far as the lower tone limit is concerned, but the upper tone limit has not yet been definitely settled. According to Zahn,¹ Sauveur believed that 6400 vibrations constituted the highest perceptible note; Chladin made the number 8192 and Walloston 25,000. "Savart showed that it was possible to hear a sound corresponding to 24,000 vibrations; Despretz was able to obtain sounds whose frequencies were over 36,000 vibrations, and Appunn makes a set of tuning forks, the highest of which is calculated to give 49,152 vibrations per second."

Some years ago Dr. Blake² made some very careful observations on this subject, using König rods for the tests and concluded that the perceptive power of hearing high musical tones varies with the age. At about 12 or 13 years of age a tone of 40,960 v. s. was heard 34 feet, while at from 28 to 30 years only tones of 32,768 v. s. were perceptible, and as the age further advanced the limit of perception still further diminished. Preyer and others have obtained similar results.

The instrument most commonly used for determining the upper tone limit is the Galton whistle, and for practical purposes it answers very well, though it is perhaps not so scientifically accurate as the high-pitched tuning forks or the König rods. Working with such a whistle, Bezold made a series of examinations and came to the conclusion that the normal high point of hearing would be registered on the whistle at 1.50. Alderton and others have placed it at 1.25 for children and from that on down to 3. or more for adults.

For some time I have been inclined to consider these points too low for a normal standard. Very frequently have I examined adults who could clearly distinguish a much higher note and I was not, therefore, very greatly surprised to find these young people doing the same. At first I thought the explanation might lie in a hyperacuity of hearing, just as we frequently find children with 20/15 or even 20/10 vision. When at the close of the work, though, I found that the vast majority of those examined had shown a much higher record than the supposed normal, I began to feel a conviction that the standard had been placed too low.

There are a number of difficulties in the way of making accurate tests with the whistle. It is hard to get a large number of individuals to distinguish, with any degree of nicety, between the sharp whistling sound and the accompanying blowing or puffing sound. As this might be especially so of very young children I shall not consider those under 10 years of age, nor shall I include those above that age who evidently did not appreciate the test. Aside from those two classes I have the records of 220 people between

10 and 20 years of age in whom I believe the test was made with a fair degree of accuracy. I may state that the whistle which I used was one made especially for the purpose under the supervision of Dr. B. Alexander Randall of Philadelphia. One perceived the whistle at 1.2; 6 at 1.; 2 at .9; 7 at .8; 41 at .7; 13 at .6; 97 at .5 and the remaining 53 claimed to distinguish it at .3 or .4 of a turn. This would give an average upper tone limit as shown by .6 of a turn on the whistle. The whistle was held from 10 to 12 inches from the ear.

It would be very unwise to draw any conclusions from this examination, inasmuch as the tests were not made with such a purpose in view and hence were not properly guarded and proven, but the evidence is presented because of its suggestive nature and in the hope that it may lead to a discussion which will throw more light on this point than I have been able to obtain from the literature of the subject. If it be anywhere near correct, then the normal limit for high tones is far above 32,000 v. s. or even 49,000 in young persons and many of these can hear over 70,000 and some over 100,000 vibrations per second.

Although not of much practical value one of the most interesting features of the examination was found in the study of the auricles and their peculiarities. Anatomical irregularities and deformities of the auricle have formed the basis of a great many papers and a great deal of consideration has been given to the question of the relation of these markings to the stigmata of degeneration, but as yet very little seems to have been done to determine what constitutes a normal ear. As a natural consequence the recorded aural examinations show no semblance of agreement upon a classification of abnormalities. The most complete classification I have seen is that given by Krauss in his article on "The Stigmata of Degeneration" in the *American Journal of Insanity*, July, 1898, but, as Hrdlicka remarks, in the report of his anthropological investigations, "It should be kept in mind, first of all, that many of the abnormalities of which we shall speak are simply the results of states of malnutrition, or certain pathological conditions, and do not indicate inferiority any more than would a pale skin after a hemorrhage or so many scars after wounds." Hrdlicka conducted a most thorough anthropologic study on 1000 white and colored children in the New York Juvenile Asylum and 100 children in the New York Colored Orphan Asylum, and his report is of extreme interest and great value. In preparing the list of irregularities observed in my examination I have merely elaborated somewhat the same arrangement he used and we may make use of some of the figures for comparison.

Hrdlicka states that "It is a fact, although we have no real statistics on this point, that any of the abnormalities met with in this institution can also be met with occasionally in the children of any class or social position." My slight experience would incline me not only to endorse but to emphasize this statement, for, as may be seen by a comparison of our statistics, I found some of the same abnormalities present in normal, healthy public school children in almost exactly

¹ Sound and Music, p. 83.

Trs. Amer. Ot. Soc., 1872.

the same proportion that he found them among the white children of the Juvenile Asylum.

Before proceeding further I should state that I have accepted and employed as a standard the following description of what constitutes a normal ear: It should be about twice as long as broad and in its attachment to the head should bear an angle of not less than 15 nor more than 30 degrees. It should have a gracefully curved outline, being nowhere pointed or irregular, have a well-defined helix, separated from the antihelix by a distinct scaphoid fossa extending down nearly to the level of the antitragus. The root of the helix should be lost in the concha before reaching the antihelix. The antihelix should not be unduly prominent and should have a well-marked bifurcation at its superior extremity. The lobules should be shapely, not adherent nor too pendulous and free from grooves extending from the scaphoid fossa.

It will be noticed, as might be expected, that the number of abnormalities was much greater among the boys than among the girls, and the difference is especially marked in the varieties of malposition and defects of the helix. This is due no doubt to the rougher life the boys lead and to their manner of applying hats, caps, etc.

The position of the auricle is considered as important as its form development, and the very large percentage of criminals showing such malposition is noteworthy. Thus, in a measurement of over 1000 criminals at Elmira, 72% showed an auriculo-temporal angle of 45 degrees or over and the same condition was found with 57% of the boy criminals at Pontiac, while a large part of the remainder had very close-set auricles (15% or less) which is likewise an abnormality. In my measurements only 0.5% showed an angle of less than 15°, and only 12.5% angles of 45° or more, leaving 87% with ears well placed.

Measurements of the auricle were carefully taken after the system devised, I believe by Bertillon, for the identification of individuals, and, if we separate the boys and girls and then divide each into groups covering periods of 5 years, we find the average measurements to be those given in Table No. 2. It would seem that the auricle gradually increases both in length and width with each year of life up to the twentieth, and I believe others have claimed that this growth continues throughout life. Certainly the most rapid growth is in the earlier years and the annual increase is slight after the fifteenth year. The largest ear measured was possessed by a boy and was 73 mm. long by 40 mm. wide, while the largest girl's ear was not far behind, being 70 mm. long by 40 mm. wide; only one other girl came within 5 mm. of this measurement, but there were five other boys inside that limit.

In 142 of the pupils there were differences, more or less slight, between the right and left ears. In some instances one ear would be larger than the other in every measurement, in some longer than the other but of the same width, or even narrower, and vice versa. In no case did the difference amount to more than 5 mm. The right ear was longer than the left in 62 instances and wider than the left in 75,

while the left was longer than the right in 48 and wider than the right in 25. So in most instances when there was a difference, the right was the larger ear.

It will not be necessary to consider the abnormalities of form in detail. Reference to the accompanying table (No. 3) will give their nature and frequency. A few specially marked instances may be worth consideration, however, not only because they represent more or less typical forms of degenerate ears that were seen in children who possessed none of the other stigmata of degeneration. The accompanying photographs were prepared for the stereoscope and lose something of their effect as reproduced.

Fig. 1. A boy, 18 years of age, of good physical development and an unusually bright student; according to his teachers, "One of the best in the school." The auricles are short and broad, 56 by 37 mm., but the auriculo-temporal angle is good. The left auricle shows somewhat better development than the right. The helix is curled in its horizontal portion, but very slightly in the upper part of the vertical portion and bends back on itself, giving the antihelix undue prominence. The concha is large and deep. The antitragus points directly outward, and the lobule is bent back towards the tip of the mastoid process.

Fig. 2. A 15-year old girl, of normal development, both mentally and physically. Left ear slightly larger than the right. The vertical portion of the helix is undeveloped and at its junction with the horizontal portion is a well-marked Darwin tubercle. In this case also the antihelix is made prominent by the bending backward of all the more external portion of the auricle—the helix and scaphoid fossa. The incisor teeth are slightly notched and there is one supernumerary on the left side.

Fig. 3. Boy, 14 years of age; physical examination shows the right shoulder a little high but no curvature of the spine. In school work he is very apt and is considered in many respects quite a genius. The ears are of normal size and position. The vertical portion of the helix is deficient, constituting merely a rim and the scaphoid fossa slopes backward and outward. On the right helix there are two distinct tubercles. The lobules are short and adherent, the inferior margin directly continuous with the cheek. The antihelix is notched just above the antitragus.

Fig. 4. A female, 13 years old, described by her teachers as an "average child, perhaps a little slow mentally." Taken in its entirety the ear is of normal size but some parts of it are overdeveloped, as the antitragus is very large and the lobule is both long and broad.

Fig. 5. A female, 8 years of age, with a good school record. The auriculo-temporal angle is a little less than 15 degrees. The vertical portion of the helix is entirely deficient, and there is practically no lobule. The concha is large and deep.

Fig. 6. A female, 14 years of age, good physical and mental development. There is practically no horizontal portion to the helix, as from the upper anterior portion after a very slight rounding the helix runs obliquely downward and



FIG. 1.



FIG. 4.



FIG. 2.



FIG. 5.



FIG. 3.



FIG. 6.

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backward, being also slightly compressed. The antihelix is prominent and the antitragus is broad and flat.

BLANK A. No.

RECORD OF EAR EXAMINATION.

Name of Scholar..... Date

Age..... Sex..... History

Condition of External Auditory Canal

Condition of M. T..... Eustachian Tube.....

Nares..... Pharynx..... Hearing

Watch R..... L.....

Whisper R..... L.....

Conversational tone R..... L.....

Aconimeter R..... L.....

F. 512 v. s. $\frac{A}{B} \frac{C}{C}$ R..... L.....

Weber F. 256 v. s. R..... L.....

Tone { Upper (Galton) R..... L.....

Limits { Lower (Forks) R..... L.....

BLANK C. No.

RECORD OF EAR MEASUREMENTS.

Name of Scholar..... Date

Age..... Sex..... Size { Length.....

Position..... Form.....

Helix..... Antihelix.....

Tragus..... Antitragus.....

Lobule..... Remarks

TABLE I.

NUMBER OF PUPILS EXAMINED, ACCORDING TO THEIR AGES.

	Boys.	Girls.	Total.
3 years of age.....	1	0	1
4 " " ".....	3	0	3
5 " " ".....	11	4	15
6 " " ".....	7	12	19
7 " " ".....	14	13	27
8 " " ".....	15	26	41
9 " " ".....	14	19	33
10 " " ".....	13	12	25
11 " " ".....	18	10	28
12 " " ".....	18	15	33
13 " " ".....	12	23	35
14 " " ".....	27	16	43
15 " " ".....	16	23	39
16 " " ".....	23	21	44
17 " " ".....	14	16	30
18 " " ".....	6	7	13
19 " " ".....	2	7	9
20 " " ".....	0	1	1
21 " " ".....	1	0	1
Total.....	215	225	440

TABLE II.

AVERAGE AURICULAR MEASUREMENTS, EXPRESSED IN MILLIMETERS.

Boys.	Length.	Width.
From 3 to 5 years of age, inclusive.....	57.2	34.8
" 6 " 10 " " " ".....	60.0	34.8
" 11 " 15 " " " ".....	62.4	34.9*
" 16 " 20 " " " ".....	63.2	35.2

Girls.

From 3 to 5 years of age, inclusive.....	52.0	30.0
" 6 " 10 " " " ".....	56.5	32.3
" 11 " 15 " " " ".....	59.0	32.4
" 16 " 20 " " " ".....	59.7	32.5

TABLE III.

ABNORMALITIES OF THE AURICLE.

	Male.	Female.	Total
Number of pupils examined.....	215	225	440
" showing abnormalities.....	..	..	113
Both ears abnormal.....	..	..	104
Right ear normal, left abnormal.....	..	..	6
Left ear normal, right abnormal.....	..	..	3
Set close to the head; angle less than 15°.	1	2	3
Flaring ears, angle 45°.....	16	4	20
" " 60°.....	7	2	9
" " 75°.....	4	2	6
" " 90°.....	5	1	6
" upper half only.....	4	..	4
Upper third bent on itself.....	2	1	3

ABNORMALITIES OF THE HELIX.

Not well folded.....	12	6	18
Compressed.....	8	5	13
Overhanging.....	9	3	12
Folded over antihelix.....	1	..	1
Vertical portion undeveloped.....	8	8	16
" " " in upper third.	2	..	2
" " " in lower third.	2	5	7
Lower $\frac{3}{8}$ of vertical portion simply a rim.	1	1	2
Upper $\frac{1}{8}$ a mere rim, upper $\frac{3}{8}$ barely visible	..	1	1
Horizontal portion undeveloped.....	1	1	2
Notched at junction of vertical and horizontal portions.....	5	5	10
Notched at junction and elsewhere.....	..	2	2
Notched on horizontal portion.....	1	..	1
True Darwinian tubercles.....	5	4	9
Small tubercles on horizontal portion....	9	9	18
" " vertical portion.....	5	3	8
Helix continuous to cheek (no lobule)....	1	1	2

ABNORMALITIES OF THE ANTIHELIX.

Very prominent.....	3	3	6
Obscure.....	2	1	3
Broad and flat.....	1	..	1
Ends in prominent tubercle.....	1	1	2
Anterior root undeveloped.....	1	1	2
Posterior " undeveloped.....	2	1	3
Deep furrow between roots.....	1	1	2

ABNORMALITIES OF THE TRAGUS.

Blind.....	3	..	3
Very broad.....	..	1	1
Notched.....	..	1	1

ABNORMALITIES OF ANTITRAGUS.

Very large.....	3	2	5
Deficient ..	1	..	1

ABNORMALITIES OF LOBULE.

Deficient.....	3	2	5
Very small.....	2	1	3
Very large.....	3	5	8
Adherent.....	1	1	2
Thickened and curled upwards.....	1	..	1
Bent back towards mastoid.....	1	..	1
Blind.....	..	1	1
Marked by continuation of fossa helicalis...	..	1	1

EXPERIMENTAL INJECTION OF TESTICULAR FLUID TO PREVENT THE ATROPHY OF THE PROSTATE GLAND IN DOGS, AFTER REMOVAL OF THE TESTES.

BY GEORGE WALKER, M. D.,

Chief of Surgical Clinic, The Johns Hopkins Hospital Dispensary, Baltimore.

(From the Anatomical Laboratory of The Johns Hopkins University.)

In order to determine the relationship which exists between the prostate gland and the testes, I have instituted a series of experiments; the first of which I herewith give as a preliminary report.

It is now a well-known fact that the prostate gland undergoes an atrophy after the removal of the testes, and these changes have been most accurately studied by several investigators whose observations I have confirmed, in several instances, for my own satisfaction and instruction. These may be summarized thus: Twelve days after the removal of the testes, there can be seen a beginning change in the epithelial cells of the prostate gland; the protoplasm first begins to clear up; the nuclei lose their chromatin structure and diminish in size. Following this, the protoplasm becomes gradually less and less, and finally at the end of about six weeks it presents only a faint rim around a small, deeply-stained nucleus. The blood-vessels, which at first were large and turgid, very soon begin to shrink, and finally many of them are obliterated; the muscle undergoes fatty degeneration and is ultimately converted into, or replaced by, fibrous tissue. After a period of from eight months to one year, the gland is reduced to about one-fourth its normal size; the glandular structure is represented by only a few small tubules, lined by shrunken and quiescent cells, and the remainder of the gland is converted into fibrous tissue.

In order to ascertain whether the atrophy of the gland is induced by the absence of some substance in the testicular fluid; or in other words, whether there is any element in this fluid which stimulates the prostate and keeps it up to a normal condition, I instituted the following series of experiments: A certain number of well-grown, well-developed and apparently healthy dogs was selected. After a few days' confinement their testes were excised; one-half of these animals were injected with testicular fluid, every other day for five months and eighteen days. The remaining dogs were kept as controls. At the end of the above time, the animals were killed, and the glands taken out and examined.

The testicular fluid was thus prepared: the testes were removed from dogs very soon after they were killed; usually about twenty-five to thirty animals being available at once. The glands after removal were carefully freed from the tunica vaginalis, and the vas; the epididymis, however, was allowed to remain. The organs were then washed with water and ground to a fine pulp; this partially-fluid mass was accurately measured and an equal volume of 50% aqueous solution of glycerine was added. The mixture was then put on ice and allowed to remain for fifteen hours, at the end of which

time it was strained several times through a fine cloth. (Repeated attempts were made to pass it through a Pasteur filter, and also through ordinary filtering paper, but so unsuccessfully that the method was discarded.) Thus prepared the testicular extract was a reddish, thick, and slightly tenacious fluid, about the consistency of glycerine. To this was added as a preservative, a small amount of trikresol, dissolved in glycerine, so that the amount of the former represented one-fifth of one per cent of the whole volume; this was not sufficient to impart any odor to the solution. The extract was kept in a wide-mouth bottle, at the ordinary room temperature, for a number of weeks, during which time it remained perfectly pure and free from bacteria. During the course of the injections about 2000 cc. of the extract were used, which represented one hundred and twenty testes.

Ten cubic centimeters of this fluid, which represented five cubic centimeters of the testicular extract were injected into the animals. The injections were begun on the third day after operations, and were made every day during the first ten days. Various parts of the back, loins and thighs were injected. The syringe used was a Parke, Davis antitoxine instrument which was cleaned before and after using by washing in a 1 to 20 solution of carbolic acid. The injections produced very little pain, and were accomplished without difficulty. No attempt was made to shave or to sterilize the skin.

After ten days the dogs became droopy, failed to eat, and were indisposed to play. The injections were stopped for several days, and they rapidly regained their former health. After this, the injections were resumed and continued every alternate day; no further trouble ensued. The uninjected animals were kept in the same place and were fed on the same food, and had in every way the same environment.

At the end of five months and eighteen days the dogs were killed by chloroform; their glands removed, examined macroscopically, and fixed in a solution containing 3% chromic acid and 5% acetic acid, preparatory to making microscopic sections.

The result may be summed up in a few words: The prostate gland in the injected animals presented both macroscopically and microscopically the same changes that had occurred in the uninjected ones. It may be said, therefore, that the injections of the testicular fluid had apparently no effect whatever, and one is probably justified in concluding that the atrophy of the gland is in no way connected with the absence of any substance in the testicular secretion.

A PLEA FOR EARLY NAKED-EYE DIAGNOSIS AND REMOVAL OF THE ENTIRE ORGAN WITH THE NEIGHBORING AREA OF POSSIBLE LYMPHATIC INFECTION IN CANCER OF THE LARYNX.¹

BY JOHN N. MACKENZIE, M. D.,

Clinical Professor of Laryngology and Rhinology, Johns Hopkins University.

Leaving out of consideration the probable existence of a cancer bacillus and the possible future detection of the disease through the blood and secretions, there remain, in the present state of our knowledge, three principal methods of diagnosis in laryngeal cancer. These are, in the order of their practical usefulness and importance: (1) The naked-eye method, or diagnosis by direct inspection supplemented by clinical phenomena. (2) Thyrotomy, and finally, (3) The microscope. Of the three methods, the second is often included in, and therefore ancillary to the first.

It is impossible to exaggerate the importance of naked-eye diagnosis in the detection of laryngeal cancer. Take it all in all, it is by far the most practical of the three methods. Unfortunately, in most quarters it is relegated to a subsidiary place. Even the best of laryngeal surgeons lose no time in procuring portions of a suspected growth for microscopic examination before they have gone thoroughly into the history of the case and carefully endeavored to make the diagnosis with the naked eye alone.

Every resource and refinement of clinical diagnosis should be resorted to before an appeal to the microscope is made.

As the advanced workers in the field of general surgery have, in the differentiation of tumors, come less and less to seek the counsel of the pathologist, except as a court of the very last resort, so should we teach ourselves to depend more and more upon the naked-eye appearance in the diagnosis of tumors in the windpipe. The removal of the "piece for microscopic examination" too often means only the beginning of the end.

The trained surgeon of to-day discriminates with marvelous accuracy (with the naked eye) between the different varieties of benign and malignant growths and we should cultivate and encourage a like amount of skill in the diagnosis of laryngeal tumors.

But, suppose, after weighing carefully all the facts of the case in our possession, a reasonable doubt remains as to the diagnosis, shall the next step be the removal of a portion of the diseased structure for examination?

In the face of all authority to the contrary, I say, emphatically, "No." Before even considering such a proposition (if it be considered at all), the suspected growth should be examined from every point of view, for in this manner alone can we give the naked-eye method its full measure of

usefulness. This is best accomplished by the second method—thyrotomy, or, if necessary, even more extensive external division of the tissues of the neck.

Thyrotomy is justifiable, in such cases, when laryngoscopic examination either leaves reasonable doubt as to its true nature, or manifestly fails to define the exact territory occupied by the disease.

Much can be learned by this method, but it too has its limits of usefulness. For, while it alone may establish with certainty the existence of cancer, it often fails to define with absolute accuracy the whole area covered by the morbid process. We can, therefore, never be perfectly sure, especially in cases in which the cancer appears as a diffuse infiltration, that we have the entire disease before our eyes. For, as I have formerly pointed out, as it is often impossible to indicate with exactness the extent of the trouble laryngoscopically, so after division of the larynx, and even after the removal of the latter organ from the body, it is by no means always possible to map out the entire distribution of the affection.

But suppose, after division of the larynx, there still remains uncertainty as to diagnosis, are we justified under the circumstances and at this stage, in removing a portion of the growth for examination? Or, to make the question still broader, is partial extirpation of the tumor ever admissible even for the purpose of microscopic diagnosis? Only as a measure of the very last resort. Before resorting to thyrotomy in general, especially if a portion of the growth is to be removed for examination, it should be clearly understood beforehand with the patient, that, if the disease should prove to be cancerous, the surgeon shall be at liberty, if in his judgment it seems best, to proceed at once to operation.

The objections which I would urge against removal of tissue for examination (especially when done through the natural passages) are (1) it subjects the patient at once to the dangers of auto-infection at the point of incision and to metastasis elsewhere; (2) it stimulates the local growth of the cancer and (3), finally, the method is often inconclusive, misleading and sometimes practically impossible.

The moment the continuity of the growth is broken, in that very moment is opened the pathway for self-poisoning, and an unfavorable influence is at once exerted on the local process. This is the solemn lesson which I have slowly learned from a sad experience in the past.

Cancer is an infectious process. Whether it be due to a bacillus, which is possible, or whether its activity be due to some vital principle inherent in the cancer cell, incision

¹ Abstract of remarks made in opening the debate on Cancer of the Larynx at the Twenty-second Annual Congress of the American Laryngological Association, May 2, 1900.

through the cancerous mass opens up at once a broad avenue for auto-inoculation. Serum therapy will some day play the most conspicuous rôle in the treatment of this disease.

For, surgical treatment, to be sufficiently radical, involves the sacrifice of so much tissue that the time must surely come when surgery will be supplanted by simpler and more certain means and with the discovery of the agent of infection will come its antidote. But to-day the knife is our only means of cure. How can we best employ it?

The general principle of treatment in cancer of the larynx is sufficiently simple. It is, or should be, identical with that which governs us in the treatment of cancer elsewhere in the organism. Total extirpation, *through liberal portions of healthy tissue*, of the growth, together with the neighboring area of possible lymphatic infection, is the cardinal principle of surgery in the treatment of this disease, for by no other method can it be thoroughly eradicated.

The surgical treatment of laryngeal cancer has resulted in failure in the past because the methods employed have not been sufficiently radical. Thyrotomy with curettage or partial removal, partial and complete removal of the larynx have fallen far short of success simply because they have not completely removed the disease. The records of the future will show that the reason so many cases have terminated in failure and death is because the disease has only been partially removed. As long as we have lymphatics to carry infection and glands to become infected, so long will the patient be subjected to ultimate danger. There is only one rational method, in the majority of cases at least, of dealing with cancer of the larynx. Early total extirpation of the entire organ with its tributary lymphatics and glands, *whether the latter be apparently diseased or not*, is the only possible safeguard against local recurrence or metastasis. By no other method can we give the patient a reasonable assurance of a permanent lease of life.

The surgeon who is abreast with the times does not trifle with cancer in other organs. Why should the larynx be made the exception to the rule? I am told that there are some gynecologists who still curette the uterus for cancer and some surgeons who still remove half the breast in that disease, but like the Democrats who still vote for Andrew Jackson for President they are becoming every day more and more hopelessly in the minority. We shall have to learn the same lesson here that we are slowly learning in the case of cancer in other parts of the body. It is the same old fight and the same old obstacles will have to be overcome.

It is often impossible by inspection either with the laryngoscope or after preliminary division of the thyroid, by transmission of light or by the sense of touch, to limit the extent of the disease before operation. As I have demonstrated, even after removal of the larynx, the disease may be apparent in one side of the organ and not in the other and yet the microscope show extensive carcinomatous deposit in the seemingly normal side. Especially is this the case in diffuse infiltration or when the epithelioma originates in the deep-seated tissues and does not approach the surface until

a late stage of the disease. The loose tissue beneath the mucous membrane in many places and its wealth in lymphatics often favor from a small focus of infection infiltration of other portions of the larynx and sometimes with great rapidity.

Diffuse infiltration, even though confined to a small area, should always awaken suspicion of the existence of the disease elsewhere in the organ, even though no apparent signs of its presence exist.

It is also possible that in its early history, we may find young cancer cells in the lymphatics, as Halsted has demonstrated in the case of cancer of the breast.

In the presence, therefore, of the fact that it is often impossible to limit the diseased area by inspection and the sense of touch, and in the light of the revelations of the microscope, it becomes a serious question whether we accomplish any lasting good by any operation short of complete excision of the larynx and the neighboring lymphatics and glands. Certainly, if the disease approaches the middle line, the imperative necessity of complete removal must be apparent to the most timid and doubting operator.

While total extirpation of the organ with the neighboring area of possible lymphatic infection should be the general rule of practice, are there exceptional cases in which a less radical method of procedure is justifiable?

Early cases in which the growth is very small (as, for example, the small papillomatous and polypoid growths, sometimes found on the cords), distinctly circumscribed, remote from the middle line and not of a specially malignant type may possibly be removed with safety by extirpation of half the larynx and the lymphatics of the corresponding side. Even here success may be due to the fact that while the growth may be pathologically malignant, it may yet be clinically benign. For example, on other mucous membranes of the body (lips, mouth, bladder, etc.), and on the skin, we find such neoplasms in which the microscope shows an epitheliomatous structure in the main body or superficial portions of the growth, but no malignant changes in base or pedicle. It is quite probable that such a condition exists in the larynx. But even in removal of half the larynx and neck lymphatics we can never be perfectly sure that we have removed the entire disease, whilst it is open to doubt whether the preservation of function which may be secured thereby is sufficient to warrant the risk. Partial preservation of function should never be attempted in the presence of the slightest danger to life.

Operations for laryngeal cancer through the mouth, done almost universally to-day, it seems to me, should no longer come within the range of serious consideration.

Thyrotomy with curettement or removal of all apparent (visible) disease is not up-to-date surgery, is in direct defiance of the rules that should govern us in the treatment of cancer, and is a reversion to, and a resurrection of a method of procedure that was discredited and abandoned over half a century ago.

Whatever operation be done, it should be forever borne in

mind that we are dealing with cancer—with an infectious process—that no matter how minute the original point of infection may be, the area of possible poisoning is practically boundless, and that, if the slightest doubt exists as to the circumscription of the growth, the complete operation should be done.

No operation for laryngeal cancer is complete without the removal of the neck lymphatics.

It is chiefly because they have not been complete, that excision of half the larynx or of the whole organ has so signally failed in the past.

The history of the treatment of laryngeal cancer is the same old wretched story of the treatment of cancer in other organs—the long and melancholy record of dismal failure after failure—the inevitable result of only partially removing the disease. What is the present status of the subject? As far as operative measures are concerned, there seems to be utter paralysis of effort—on every side we are confronted by practical failure. Without stopping to inquire how far apparent success in partial removal of laryngeal cancer may be due to mistakes in diagnosis or to the simple accident of

good fortune, it is safe to say that in the present state of our knowledge the outlook is extremely unsatisfactory and sombre. In the presence of the great uncertainty that surrounds operations for partial removal and in the light of our experience in the modern treatment of cancer in other organs of the body, shall we resort to complete extirpation of the larynx with the neighboring area of possible infection, or shall we cling with fatuous persistency to what some one has called, with cruel felicity of expression, the “incomplete operation,” under which term must be included all surgical procedures hitherto resorted to in this disease?

The time will surely come, if it has not already come, when the conscientious surgeon will consider that he has fallen far short of his duty both to his patient and to himself if he does not, in the treatment of cancer of the larynx, remove not only the entire organ, but also the neighboring lymphatic area. Then and not until then, will we have more favorable statistics and prognosis in cancer of the larynx. Then and not until then, will the medical historian chronicle a real advance in the management of this terrible disorder.

HEREDITY IN DIABETES MELLITUS, WITH A REPORT OF SIX CASES OCCURRING IN A FAMILY.¹

BY J. HALL PLEASANTS, M. D.

I wish to report six cases of diabetes mellitus occurring among the members of a single family in three generations. The cases are of special interest since they illustrate very well certain features of the hereditary form of diabetes. Five of the six cases have been under personal observation.

Heredity has been long recognized as a factor in the etiology of diabetes, but its importance has been generally underestimated. The first reference to diabetes as a family disease which I am able to find in the literature occurs in Richard Morton's *Opera Medica, Amsterdam, 1696*. In his chapter on diabetes he cites the case of a father and son who suffered from the disease. Among other early writers who called attention to the fact that heredity may sometimes enter, were Blumenbach and Isenflamm. In Rollo's *Cases of Diabetes Mellitus, 1798*, Storer of Nottingham directed attention to what he termed “mild habitual or family diabetes,” and cited two families in which several members were diabetic. In one of these cases the father is said to have died of diabetes, while a son, a daughter and a granddaughter suffered from a mild type of the disease. Thomas in the same work reports a similar case. During the present century numerous writers have contributed to our knowledge of the part played by heredity.

Statistics showing the proportion of cases of diabetes in

which heredity enters vary considerably, as the following figures, which I have collected, illustrate:

Flint ²	27.7%
Bouchard ³	25
Fitz and Joslin ⁴	23.8
von Noorden ⁵	21.8
Schmitz ⁶	21.1
Seegen ⁷	14
Naunyn ⁸	11.7
Zimmer ⁹	10.6
Williamson ¹⁰	10.5
Frerichs ¹¹	9.75
Grube ¹²	7.9
Johns Hopkins Hospital Series (112 cases)	5.3
Wegeli ¹³ (in children)	2.9

The marked variation in these figures is probably largely due to the class of patients upon which the different statistics are based. Those based upon hospital and dispensary cases are lower, owing to the difficulty in obtaining satisfactory medical histories from such patients. Thus Naunyn ⁸ reports from his private practice 17-20 per cent of cases giving a history of heredity, while of the patients from his clinic only 4.4 per cent gave such a history. For the same reason the figures based upon an analysis made by Dr. T. B. Fletcher and myself of 112 cases treated at the Johns Hopkins Hospital and Dispensary up to June 1, 1900,

¹ Read before the Johns Hopkins Hospital Medical Society, June 4, 1900.

are low. Fitz and Joslin omit cases in which the family history has not been especially inquired into, so that their figures are of especial value. It seems probable that heredity enters in from 20 to 25 per cent of all cases of diabetes.

A study of 60 cases of diabetes in which an hereditary history was obtained, founded upon an analysis of six cases treated at the Johns Hopkins Hospital and upon the series of cases reported by Flint,¹⁵ Fitz and Joslin¹⁶ and Naunyn.¹⁷ shows the occurrence of the disease among other members of the family as follows: father 15, mother 5, brother or sister 21, two sisters 1, brother and sister 4, uncle 7, aunt 3, grandfather 1, father and uncle 1. In two instances several members of the family were affected. One of these is the case reported by Flint in which six members of the family were diabetic. The other instance is that of the family reported in this paper. These figures show the frequency with which the disease occurs in a brother or sister, or in a collateral relation. In only 20 of the 60 cases was one of the parents diabetic. In only 8 of the series were more than two members of the family affected.

While it is comparatively rare to find more than two or three cases occurring among the members of a single family, there are several instances on record in which numerous individuals have been attacked in successive generations. The most remarkable of these is a case reported by von Noorden,¹⁸ who publishes a pedigree of the family in question. In this case the disease affected ten members of a family in four generations, appearing in each successive generation at an earlier age. The family history was further complicated by intermarriages with other diabetic families. Isenflamm¹⁹ reported seven diabetic children in a family. The editor of the *Indian Medical Gazette*²⁰ cites a case in which eight members of a Hindoo family in three generations are said to have suffered with diabetes. The following cases will be simply referred to: Flint²¹ (the case already mentioned), father, paternal uncle, two sisters, and two brothers—only one case recorded and observed. Senator²²—four children of a Polish Jew. Hertzka²³—three brothers and a sister. Naunyn²⁴—mother and four children. Bence Jones²⁵—three brothers and a sister. Mosher²⁶—father and mother, three daughters and a grandson. Frew²⁷—child nine years old, uncle, aunt and grandfather. These are among the most striking cases which I have been able to collect from the literature and serve to show that diabetes may be at times distinctly a family disease. In many of these cases the writers have had but a single member of the family under observation, the occurrence of the disease among the other members being founded upon hearsay. In this connection attention may be called to the fact that several observers have found that in diabetic families there is often a history of epilepsy, insanity and the various psychoses. Obesity is often a characteristic of diabetic families, occurring in both diabetic and non-diabetic members. Syphilis has also been considered as playing an important rôle—one writer, Schnée,²⁸ going so far as to say that all cases of hereditary diabetes are due to lues in some ancestor.

The occurrence of diabetes in husband and wife is by no means uncommon, Schmitz²⁹ reporting 26 cases out of a total of 2320. Although 1.12 per cent seems a large figure, it is the general opinion that such cases of "conjugal diabetes" are accidental, and considering the comparative frequency of diabetes, cannot be regarded as affording evidence, that under these circumstances, the disease is ever contagious.

From a study of the reported cases of diabetes mellitus in which heredity enters and of my own cases, certain peculiar features of the family type of the disease are to be noted.

(1) The occurrence of the disease in an uncle, aunt or cousin, while the parents escape, is very often observed. This may be conveniently spoken of as the "collateral inheritance" of diabetes. In the same way a grandparent may be diabetic while the parent escapes.

(2) When successive generations are affected there is a tendency for the disease to develop at a progressively earlier age.

(3) When more than two members in the same generation are diabetic there is a tendency for the disease to appear at approximately the same period of life.

(4) While hereditary diabetes developing in the first two decades is often of a severe character, the cases developing later in life are generally of a mild type.

(5) In a certain number of cases the disease has appeared in the children prior to its occurrence in the parents.²

(6) There is frequently a neuropathic tendency in diabetic families. Cases are recorded in which several children were diabetic, while the others suffered from various psychoses.

(7) Obesity is often a characteristic of families in which diabetes occurs.

The cases which I wish to report to-night occur in two brothers and two sisters, an uncle and a great uncle, as is shown in the accompanying chart-pedigree. With the exception of the great uncle, Heinrich D—— who died in Germany about fifteen years ago all the cases have come under my personal observation. Apart from the diabetic taint the family history shows nothing of especial interest. All of the 23 descendants of the emigrant, Augusta M——, who are now living, are residents of Baltimore. With one exception, I have fortunately been able to make an analysis of the urine of all of these. In addition to these, one member of the family suffering from diabetes recently died at the Johns Hopkins Hospital, so that including Augusta M—— I am thus able to report upon the condition of 24 members of the family. In view of the interest at present attached to the so-called "conjugal diabetes," wherever possible the condition of those persons who have married into the family has been investigated. The result of these inquiries has so far been negative. The average of intelligence in the family is excellent. There is no history of epilepsy, insanity or other nervous trouble. One of the *diabetic* members of the family

² Two such cases are reported by Niessen,³⁰ Naunyn³¹ and Grube³² each report a case.

—John M— has, however, had two attacks of delirium tremens. No luetic history is obtainable. Not a single member of the family is stout, but it is of interest to note that the father of the four diabetic brothers and sisters is a very large man, although the diabetic taint comes through the mother.

The following is a summary of the cases:

CASE I. Heinrich D—, the great uncle of Goslar, Germany, is said by his sister to have died of "Zuckerkrankheit" fifteen years ago at the age of forty. Three years before his death he was severely injured by a falling tree. Soon after the injury his general health began to fail. About one year previous to his death sugar was found in the urine. No further details of the case are obtainable.

CASE II. John M— the uncle—aged 28.

Complains of nervousness.

Past History.—No acute diseases except measles and malaria, the latter two years ago. During the past seven years has suffered much from nervousness brought on, he thinks, by excessive drinking. Has had two attacks of delirium tremens within the past year. No history of lues.

Present Illness.—December 15, 1899, he was examined for admission into a beneficial society, and his urine found to contain sugar. Previous to this he did not know of the existence of diabetes. The examining physician reports to me that on two subsequent occasions sugar in large amounts was found to be present. The classical symptoms of diabetes are not very marked—the patient does not drink a very large amount of water, the urine is but slightly increased in amount, the appetite is moderate and there has been no marked loss in weight. He refuses to submit to a special diet.

Physical Examination.—The patient refuses to allow me to make a physical examination. In appearance he is tall and well developed. Color rather sallow. Seems very much upset about his condition. The examining physician informs me that nothing especial is to be made out in the chest or abdomen.

Urine Analysis.—This has been made by me twice. April 6, 1900: Sugar present, but the amount unfortunately not determined. Specific gravity 1036. No albumin or casts. April 24, 1900: Sugar .4%. Specific gravity 1020. Trace of albumin, no casts. No diabetic, β -oxybutyric acid or acetone present on either occasion. On the whole the case seems to be rather a mild one.

Cases III, IV, V and VI are brothers and sisters.

CASE III. Jacob S— nephew—aged 20. Tailor by occupation. Came under observation March 30, 1900.

Complains of loss of voice and general weakness.

Past History.—No acute diseases except pneumonia when a child. No luetic history. Habits have always been good. Slight cough with expectoration for several years. One year ago his voice began to become weak and his cough more troublesome. The diagnosis of tuberculous laryngitis was made at the Johns Hopkins Hospital Dispensary, although diabetes was not suspected.

Present Illness.—There is no definite history of onset.

About one year ago the patient began to suffer from thirst and dryness of the throat. Drinks a rather large amount of water at times. Frequently voids two or three litres of urine a day. Appetite is large. During the past year there has been considerable loss in strength and weight. There is no pruritus. Now suffers from severe cough and night sweats.

The patient did not know of the existence of diabetes until four or five months ago when he was informed of the fact by his physician. Since then he has been at times on a restricted diet.

Physical Examination.—In appearance the patient is a frail and badly-nourished boy. Very anemic; no zanthomata or other cutaneous lesions; no dryness of the skin; no fruity odor of the breath. The throat examination shows tuberculous ulceration of the larynx. Examination of the lungs shows an advanced tuberculous process in the upper left lobe while there are signs of beginning involvement of the right apex. The physical examination is otherwise negative.

Urine Analysis.—March 29, 1900. Urine shows 2.9% of sugar. No diabetic acid; β -oxybutyric acid or acetone; urine otherwise negative.

CASE IV. Charles S— nephew—aged 16; clerk. Came under observation March 30, 1900.

Complains of dryness of throat.

Past History.—No acute diseases except measles and chicken-pox; no luetic history; no history of malaria. Habits have always been good.

Present Illness.—The patient says that his general health is good. For the past year he has been troubled with dryness of the throat. Five months ago he had two fingers cut off by machinery. Following this for several days he was very nervous and had a low fever which his physician called "malaria." Since then the dryness of the throat has increased. For the past year he has taken a good deal of water to drink; his appetite has increased and the amount of urine has increased. All these symptoms have become more marked since the accident. He thinks that there has been a slight loss in weight.

The patient was not aware of the existence of diabetes.

Physical Examination.—The patient is a well-developed and well-nourished boy, slightly anemic in appearance. There is no fruity odor of the breath. No zanthomata or other skin lesions; no dryness of the skin. The examination of the throat, thorax and abdomen is negative. Both knee-jerks are absent.

Urine Analysis.—This has been made twice. The patient has not been on a restricted diet. March 29, 1900. Sugar 3.7%; specific gravity 1037; no diabetic acid or β -oxybutyric acid. There is a distinct trace of acetone. Urine otherwise negative. March 31, 1900 (24 hours' specimen); amount in 24 hours, 2050 cc.; sugar 5.3%; specific gravity 1041. No diabetic acid, β -oxybutyric acid or acetone.

CASE V. Augusta S— niece—aged 16; schoolgirl.

Came under observation April 1, 1900.

There is no complaint about her health.

Past History.—The patient has always been strong and

healthy. Chills and fever every other day when about six years of age. Measles and chicken-pox as a child. The patient is subject to attacks of tonsillitis. She first menstruated five months ago.

Present Illness.—The patient says that she feels strong and well. Her appetite is quite large; drinks a good deal of tea and coffee; does not suffer much from thirst; no dryness of throat; voids between two and three litres of urine a day. The patient does not know how long she has been voiding this much, and has never thought the amount excessive. It is impossible to assign the time of onset of the disease. There is no dryness of the skin, zanthomata or skin eruption. The patient was not aware of the presence of diabetes.

Physical Examination.—The patient is a well-developed and very well-nourished girl. The complexion is brilliant. Lips and mucous membrane are of a good color. There is no fruity odor of breath. There are no zanthomata. An examination of thorax and abdomen is not permitted. Seems in excellent general physical condition.

Urine Analysis.—Two analyses have been made. The patient has not been on a special diet. April 1, 1900: Sugar 1.5%; considerable albumin; no diabetic acid, β -oxybutyric acid or acetone. April 30, 1900: Amount in 24 hours 2600 cc.; sugar 1%; specific gravity 1016. No diabetic acid, β -oxybutyric acid or acetone; trace of albumin.

CASE VI. Drueilla S—niece—aged 10. Schoolgirl.

Admitted to the Johns Hopkins Hospital March 22, 1900
Died April 6, 1900.

Admitted complaining of rheumatism.

Past History.—Measles when six years of age. There have been three previous attacks of rheumatism; no history of malaria.

Present Illness.—For three weeks preceding her admission the patient had been suffering with acute articular rheumatism. She also complained of pain about the heart. Had never noticed that she drank much water or that she voided much urine. Appetite is not large. At times she had pruritus of the scalp. There has been no decrease in strength or weight.

Physical Examination.—The patient is a fairly well-nourished girl. Not anemic in appearance. There are no zanthomata or other cutaneous lesions; no dryness of the skin; odor of breath not fruity. There is considerable tenderness over the involved joints. The heart-dulness is increased, and there is a loud systolic murmur at the apex. A marked friction rub is heard over the body of the heart. Nothing further made out on examination.

After admission to the hospital her condition gradually became worse. She died April 6, 1900, with all the symptoms of cardiac disease. During the greater part of her illness there was considerable fever, often reaching 104°. None of the symptoms of diabetic coma were present at any time. The blood examination did not show the existence of lipemia. There was a slight reaction with Bremer's test.

The patient was at no time on a diet entirely free from carbohydrates.

Urine Analysis.—During the fifteen days that the patient was under observation in the hospital a very careful daily determination of the sugar, diabetic acid, β -oxybutyric acid, acetone, ammonia and urea was made by Dr. Erlanger. The amount of urine in 24 hours varied from 740 to 2260 cc. The sugar ranged from 1.5 to 4.6%. The specific gravity ranged from 1016 to 1039. At times, diabetic acid, acetone and β -oxybutyric acid were all detected in the urine, the latter on one occasion reaching .35%. The urine towards the last contained a trace of albumin, but no casts.

Autopsy.—Fortunately a post-mortem examination was obtained. The heart showed the presence of a marked endocarditis and a serofibrinous pericarditis. The examination of the abdominal organs showed nothing of importance. The pancreas was possibly slightly enlarged, but microscopical examination revealed nothing abnormal. The liver was practically normal. The brain and cord could not be examined.

An analysis of these six cases brings out certain points of interest which illustrate well some characteristic features of hereditary diabetes. An inspection of the chart-pedigree shows that the disease was probably inherited through the great grandfather Bernhard D—, as he has diabetic descendants through both of his wives, although considering the advanced age at which he died—88—it is improbable that he himself suffered from the disease. The grandmother—Augusta D—is living and well. Her urine is absolutely negative. The same is true of Theresa S—, the mother of the four diabetic children. These cases thus bring out very well what I have called the "collateral inheritance" of diabetes, there being probably no history of diabetes in an ancestor in three generations at least. The age at which the disease has first made its appearance is a more difficult matter to determine. In the case of the great uncle it was discovered at 40, in the uncle at 28, and in the four nephews and nieces at ages ranging from 10 to 19. We have here the disease appearing in succeeding generations at a progressively early age. In the third generation the disease has appeared approximately at the same period of life; i. e., all the cases are in the second decade. In regard to the severity of the disease in the family under consideration, it is as yet, too early to speak definitely. The cases at present under observation do not seem to be of a severe type, in some of the cases the existence of any trouble being unsuggested. In the one fatal case which I have been able to observe, death was not due to diabetes. As stated previously there is no definite neurotic family history or history of obesity.

The negative evidence which has been brought forward by a study of the urine of 24 out of 25 members of the family, is of interest, and should additional members of the family at a later time develop the disease, will be of importance in determining the time of its onset. If possible the family will be kept under observation and any later developments which may be of interest will be reported.

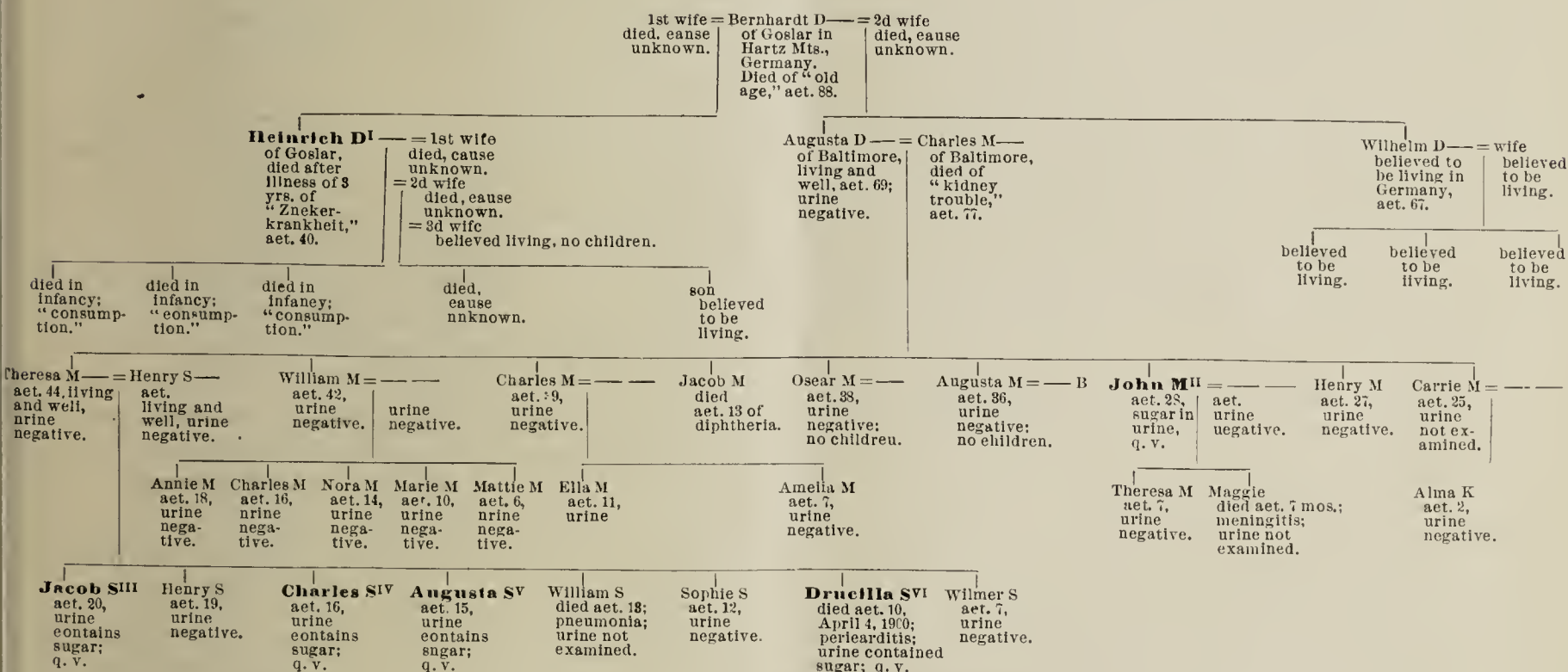
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29. Schmitz: *Berl. klin. Wochenschr.*, 1890, XXVII, 449.
30. Niessen: *Therap. Monatsch.*, Berl., 1897, XI, 529.
31. Naunyn: Loc. cit., 76.
32. Grube: Loc. cit., 468.

CHART-PEDIGREE.



SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

HOWARD A. KELLY, M. D. The Evolution of My Technique in the Treatment of Fibroid Uterine Tumors. Read before the American Gynecological Society, at Washington, D. C., May 3, 1900. Published in the *American Journal of Obstetrics*, Sept., 1900. (Illustrated.)

The methods of enucleation in certain difficult cases of myoma uteri by (1) median sagittal bisection of the uterus with the tumors, (2) bisection of the tumor alone or (3) coronal section of the uterus, briefly described in a preliminary report in the *JOHNS HOPKINS HOSPITAL BULLETIN* for March, 1900, are here described in detail with accompanying explanatory figures.

— Gynecology, Its Present, Past and Future.—*Philadelphia Medical Journal*, September 22, 1900.

— Methods of Teaching Gynecology.—*Philadelphia Medical Journal*, September 1, 1900.

— Resection and Anastomosis of the Divided Ureter. Presented to the Section on Obstetrics and Diseases of Women, at the Fifty-first Annual Meeting of the American Medical Association, Held at Atlantic City, N. J., June 5-8, 1900. Published in *The Journal of the American Medical Association*, October 6, 1900. (Illustrated.)

I take it that a urethral anastomosis is about as difficult and as delicate a piece of surgical work as we are called on to execute upon the human body, fully as delicate as the most difficult operation on the eye.

Injuries of the ureter requiring anastomosis are almost ex-

elusively surgical, that is to say, they are produced in the course of operations when they can often be detected at once and immediately repaired. The injury is almost invariably confined to the pelvic portion of the ureter, and if any part is sacrificed the loss is limited to the pelvic end. The injury is, for the most part, involuntary on the part of the operator, as when he cuts a ureter for a blood-vessel or unwittingly picks it up along with the ovarian vessel at the pelvic brim and ligates and divides it there. In other instances it is torn out of the pelvis with an adherent ovarian cyst, myoma, pyosalpinx, extra-uterine pregnancy or tuberculous mass. A voluntary sacrifice is made when the ureter passes through a carcinomatous mass in the broad ligament in caliber." An instrument which Kelly uses to overcome these difficulties, known as a ureteral guide, is then described and the manner of using it is explained. Then follows an abstract of six cases in which anastomosis of the ureter was performed.

ROBERT L. RANDOLPH, M.D. A Review of Recent German Ophthalmic Literature for the Quarter Ending June 30, 1900.—*Annals of Ophthalmology*, July, 1900.

——— An Insurance Case in Which Ossification of the Choroid Led to the Identification of the Body.—*Ophthalmic Record*, July, 1900.

The case was that of a man whose body had lain at the bottom of the Niagara river for nine months. When discovered, the body was so badly decomposed that the insurance companies refused to pay the insurance, claiming that it was impossible to identify the remains. The family, however, remembered that one eye (left) had been blind for years from an injury. The eyes were examined and an ossified choroid in the left eye was the only remaining recognizable structure which was found. This was sufficient to show that the eye had been blind for years and the companies accepted the evidence as conclusive and paid the insurance.

THOMAS R. BROWN, M.D. Poisoning with Snake-Venom.—*Twentieth Century Practice of Medicine*, Vol. XX, pp. 491-538.

In this article the subject of poisoning with snake-venom is considered in full.

The subdivisions of the article treat of the poison-apparatus of the snake and the mode of injecting its venom; varieties of poisonous snakes and their distribution; the properties of snake-venom; chemistry of venom; toxicity of various venoms and causes of variations in toxicity; effect of heat, cold and various reagents upon venom; effects of various digestive ferments upon venom; relation of venom to various other products of albumin hydration; mode of entrance of the venom into the body; mode of elimination of venom; symptomatology; morbid anatomy; physiological and pathological effects of snake-venom, as shown by experiments upon animals; diagnosis; causes of death in snake poisoning; prognosis; prophylaxis; treatment, local and general or constitutional; treatment with antivenomous serum and the production of artificial immunity; immunity of snakes and certain animals; specificity or non-specificity of antivenomous serum; relation between snake-venom and antivenene; treatment of other diseases with snake-venom and antivenene; medico-legal value of antivenene.

Especial attention is paid to the treatment of snake-bite by antivenomous serum or antivenene, while the rôle that this serum has played in establishing our views regarding the relation between toxin and antitoxin is carefully considered.

At the conclusion of the article there is a carefully compiled bibliography of all the important works published on this subject since 1886, Weir Mitchell having furnished a complete bibliography up to that time.

JOSEPH C. BLOODGOOD, M.D. Traumatic Rupture of the Popliteal Artery with Gangrene of the Leg—Amputation—Recovery.—*The Maryland Medical Journal*, September, 1900.

The case was one of dislocation backwards of the right knee-joint, with a subcutaneous complete transverse rupture of the popliteal artery at its bifurcation. The popliteal artery was plugged with a thrombus. There was no hematoma in the popliteal space. Thrombosis of the popliteal vein was diagnosed. Gangrene of the leg began immediately after the injury. The condition of the patient, when admitted three hours after the injury, was one of extreme shock, not associated with great loss of blood. The patient was observed for three days; there was a high temperature (104.8° F.) and a leucocytosis of 8000, due probably to fibrin ferment, as the extravasated blood and gangrenous tissue were sterile. There was amputation through the condyles of femur on the third day, and the patient recovered.

WALTER JONES, M.D. Ueber die Darstellung des Thymins.—*Zeitschrift für physiologische Chemie*, Bd. 29. Heft. 6.

J. H. MASON KNOX, JR., M.D. Compression of the Ureters by Myomata Uteri.—*The American Journal of Obstetrics*, September, 1900.

HENRY J. BERKLEY, M.D. Clinical Cases, VI.—Death from an Unusual Cause in a Case of Dementia Paralytica.—*American Journal of Insanity*, July, 1900.

OTTO G. RAMSAY, M.D. The Surgical Treatment of Primary Renal Tuberculosis, with a Consideration of the Immediate and Remote Results after Operation.—*Annals of Surgery*, October, 1900; *Annals of Gynecology and Pediatrics*, June, 1900.

HUGH H. YOUNG, M.D. Suprapubic Retrocystic Extraperitoneal Resection of the Seminal Vesicles, Vasa Deferentia, and Half of the Bladder.—*Annals of Surgery*, October, 1900.

J. WHITRIDGE WILLIAMS, M.D. Teaching Obstetrics.—*Philadelphia Medical Journal*, September 1, 1900.

JOHN J. ABEL, M.D. On the Teaching of Pharmacology, Materia Medica, and Therapeutics in Our Medical Schools.—*Philadelphia Medical Journal*, September 1, 1900.

LEWELLYS F. BARKER, M.D. The Anatomical-Cytological Relationship of the Neurone to Disease of the Nervous System.—*Journal of Nervous and Mental Diseases*, September, 1900.

HUNTER ROBB, M.D. Notes on the Enemata Employed after Abdominal Sections.—*Cleveland Medical Gazette*, September, 1900.

W. W. FORD, M.D. Sarcoma and Cirrhosis of the Liver.—*American Journal of the Medical Sciences*, October, 1900.

WILLIAM E. HUGER, M.D. Report of a Case of Eneysted Periurethral Gravel.—*Maryland Medical Journal*, October, 1900.

STEWART PATON, M.D. A Study of the Neurofibrils in the

Ganglion Cells of the Cerebral Cortex.—*Journal of Experimental Medicine*, Vol. V, No. 1.

WILLIAM OSLER, M.D. General Summary of the Cases of Typhoid Fever Treated in the Johns Hopkins Hospital for Ten Years.—*Philadelphia Medical Journal*, October 13, 1900.

—— The Visceral Lesions of the Erythema Group.—*British Journal of Dermatology*, July, 1900.

JESSE W. LAZEAR, M.D. Pathology of Malarial Fevers, Structure of the Parasites and Changes in Tissue.—*Journal of the American Medical Association*, October 13, 1900.

PROCEEDINGS OF SOCIETIES.

THE LAENNEC.—A SOCIETY FOR THE STUDY OF TUBERCULOSIS.

Tuesday, October 30, 1900.

This Society has been organized to systematize and stimulate the work on tuberculosis in the hospital, to educate its members, and to diffuse in the profession and the public a knowledge of the disease. Monthly meetings will be held throughout the session. The programme will consist of a historical review of the great epochs relating to the disease, a critical summary of the conditions relating to tuberculosis in the United States, with a presentation from each of the departments of the hospital of the work on tuberculosis during the first decade, and minor items relating to the symptomatology of the disease. Dr. Osler was elected Chairman of the Society.

I. *Introductory remarks* by the Chairman dealt with the importance of the study of tuberculosis in the profession, and he emphasized the fact that the chief work in the battle with the disease must be done by the general practitioner.

II. *Tuberculosis in the writings of the Fathers to Galen.*—Dr. Osler summarized and read extracts from the writings of Hippocrates, Aretæus, Celsus and Galen. The fairly full knowledge possessed by Hippocrates is indicated by the following statements: He knew that it was the most common of all diseases. He recognized it also as a febrile disease. He mentions its hereditary character. He describes what has been called the phthisical habit of body. He knew the significance of hæmoptysis and its relation to consumption. Many of the clinical features were known accurately—the fever, the cough, the sweats, the diarrhœa, the falling of the hair, the change in the finger tips. He did not know it as a special malady or a specific disease, but it was believed to arise either from an inflammation of the lung which terminated in abscess, or when the pituita or phlegm dropped in large quantities from the head to the lungs and changed into pus, when the blood in a hæmorrhage from the lungs was converted into pus, and, lastly, as a consequence of pleurisy. The contagious nature of the disease is apparently not mentioned by Hippocrates, though it is stated to have been known to his contemporaries, and is referred to by Galen.

The remarkable description by Aretæus of the general features of consumption was then read.

III. *Report on the social and domestic conditions of 190 cases of pulmonary tuberculosis in attendance at the Medical Dispensary of the Johns Hopkins Hospital*, by Miss Adelaide Dutcher.—Two years ago some friends presented the hospital with a sum of money which was to be used in promoting the work on tuberculosis, and it was felt that an important practical help could be given if in every case of tuberculosis applying to the hospital for relief some one would visit the patient's house and give personal instructions as to the mode of life and the care of the sputa. This has been carried out faithfully, first by Miss Epler, and during the present year by Miss Dutcher, who presented a report of the year's work. She divided the cases into three groups—of the whites (exclusive of the Russians), the Russian Jews and the colored. So far as the sanitary surroundings were concerned, the following were the figures:

	Rus.	Bl.	W.
Bad sanitary location	69%	40%	30%
Insufficient light and ventilation.....	83	71	46
Overcrowding	76	50	46
Personal and household uncleanness...	75	66	43

A full report of the paper will appear in the BULLETIN.

IV. *Suggestions for a Library on Tuberculosis*, by Dr. Welch.—It is proposed, in connection with the tuberculosis fund, to establish a library in which all of the important works on the subject will be gathered. The subject was discussed under the following heads:

1. Historical—the monographs of Waldenburg and Predohl.
2. Epochal works of the first rank.
3. Epochal works of the second rank.
4. General or comprehensive works—ancient and modern.
5. Works and monographs on special aspects of the disease.
6. Tuberculosis of special organs.
7. Transactions of Congresses.
8. Journals devoted to tuberculosis.
9. Records relating to the crusade against tuberculosis.

This paper also will appear in a subsequent number of the BULLETIN, and it will be very helpful to students interested in the disease.

NOTES ON NEW BOOKS.

Bacteriology and Surgical Technique for Nurses. By EMILY M. A. STONEY, Superintendent of the Training School for Nurses, St. Anthony's Hospital, Rock Island, Ill. (*Philadelphia: W. B. Saunders & Co., 1900.*)

This little volume contains a short and comprehensive account of what is meant by bacteriology. It is hardly to be thought that nurses will know much more than the actual terms used in the description of bacteriological technique; this volume seems to furnish fully as much information as they can appropriate in regard to bacteriology. It is well at least that they should know the relation of bacteriology to disease.

The latter part of the book contains a good account of antiseptics, disinfectants and surgical technique. It is, of course, a compilation, but the knowledge seems to have been judiciously gathered. The information is clearly and concisely given.

Transactions of the Medical Association of Georgia. Fifty-first Annual Session, 1900. (*Atlanta, Ga.: The Franklin Printing and Publishing Company, 1900.*)

This volume, of upwards of 400 pages, contains the usual number of papers read at the meeting of any State Medical Society. Some of them, it is probable, were mainly interesting to the writers, as, for example, "False Gods and Fake Priests of Medicine," or "The Physician the Nation's Guardian." The majority of the papers, however, are upon practical subjects, and many are valuable. One paper, on the "Woodbridge Treatment of Typhoid Fever," is largely polemic in character. It is interesting to notice that the author speaks of using the Woodbridge tablets of various numbers (1, 2, 3) in the multifarious complications of the disease. The conception of typhoid fever as an entity which can be combated by routine remedies prepared to order is, to say the least, a singular one at this age of the world. The Medical Association of Georgia is to be praised for the excellent character of most of the work done at the annual session.

The book is well printed. It would have been much improved by a careful, analytical index.

A Book of Detachable Diet Lists.¹ By JEROME B. THOMAS, JR., A. B., M. D., Instructor in Materia Medica, Long Island College Hospital. (*Philadelphia: W. B. Saunders, 1900.*)

Some time since we had occasion to notice the first edition of this book. The second edition has been improved in many ways. The lists presented are sufficiently varied to meet the wants of the sick-room, and the system of detachable slips is a great convenience to the busy practitioner. It is a useful and convenient little book.

Tuberculosis; Its Nature, Prevention, and Treatment, with Special Reference to the Open-air Treatment of Phthisis. By ALFRED HILLIER, B. A., M. D., C. M., Fellow of the Royal Medico-Chirurgical Society, London. (*London, Paris, New York and Melbourne: Cassell & Company, Limited, 1900.*)

This admirable little book should be in the hands of every physician. Although written for conditions existing in England, it is equally valuable for conditions in this country. It gives a detailed and readable account of tuberculosis; its means of transmission from man to man and from animals to man. It also treats clearly of the methods of prevention. It shows that tuberculosis is not inherited, but transmitted; that the disease is not infectious or contagious, in the ordinary sense of the term, but communicable. The plea made for the careful examination of herds of cattle to prevent the sale of contaminated milk,

should be listened to in every city, as also the general statement that all milk from suspicious sources should be boiled. In fact, in the light of recent outbreaks of typhoid fever, it is not too much to say that all milk procured in the open market should be boiled before it is used. In no other manner can it be made safe for the consumer.

The chapters on treatment are excellent. Of course the open-air treatment is recommended. The author makes a necessary distinction between living in the open air and needless, reckless exposure to inclement weather. We are glad to see also a protest against the notion that tuberculosis is prevented by hardening children. The rationale of the open-air treatment is very well stated in the following extract: "Pure air cannot destroy the microbe buried in the tissues, but it can so intensify and invigorate the cellular elements of those tissues as to enable them to do so, and this it does not merely by its oxygen or by its comparative freedom from carbonic acid, but by virtue of its freedom from the organic impurities which the respiration contains, those impurities thrown off among other effete or waste products of combustion within the body through the channel of the expired breath. Provide the cells of the tissues with pure air, a normal requirement, and the fungus, the tubercle bacillus, is either checked or destroyed in its growth upon them. But, on the other hand, as manure an effete animal product, put into land causes the vegetable seed sown in it to flourish; so do these respiratory organic impurities (another form of manure), or effete animal product, reinhaled into the lungs and reabsorbed by the tissues, cause the vegetable fungus, tubercle bacillus, to flourish. Some one has described breathed air, which is saturated with respiratory impurity, as containing air sewage. The term exactly describes the condition, and this sewage constantly bathing the soil or tissues of the consumptive causes the vegetable tubercle bacillus to grow and thrive in them. Cut off the supply, or, in other words, subject the patient to open-air treatment, and the bacillus is starved and checked in its growth."

In the latter part of the book excellent views of sanatoria for consumptives are given. There seems no reason why in every State of the Union similar inexpensive buildings should not be erected for the treatment of consumption. As the author well says, the treatment of consumption is not a matter of latitude or climate, but rather of altitude and dryness of the air.

A Manual of Personal Hygiene. Edited by WALTER L. PYLE, M. D., of Philadelphia. (*Philadelphia: W. B. Saunders & Co., 1900.*)

The editor does not tell us in his preface for what constituency his book is a candidate. There are many things in the work that are too simple to be meant for the profession, and others that are too professional for the laity. Yet both will find much good common-sense advice as to many matters of personal hygiene. The object of the work is to give "the best means of developing and maintaining physical and mental vigor." There are seven sections contributed by different authors. Dr. Stockton, of Buffalo, writes on the hygiene of the digestive apparatus. In addition to matters of food and drink, the care of the teeth is fully described. Dr. Fox, of New York, writes on the skin and Dr. Ingals, of Chicago, on the respiratory organs. Probably the most valuable chapter is by the author himself on the hygiene of the eye. Sections on the ear by Dr. Randall, on the brain and nervous system by Dr. Courtney, and on exercise by Dr. Stewart complete the book.

Practical Urinalysis and Urinary Diagnosis. By CHARLES W. PURDY, M. D., Chicago. (*F. A. Davis Company, 1900.*)

This is the fifth edition of Dr. Purdy's work and contains much new matter. The amount of work done by the author

¹ Second edition, revised.

on centrifugal analysis is well known, and in this new edition many more data for quantitative determinations by this method are given. These should be of much assistance clinically, as estimations can be made in a comparatively short time. There is an excellent section on the methods of microscopical examination, in which emphasis is put on the characteristics of the so-called false casts. This is an important point, as few works on this subject give more than a brief description of theory, and too often they are mistaken for hyaline casts. Dr. Purdy is to be congratulated on this last edition, which we expect to find as helpful as we have previous ones.

Clinical Examination of the Urine, and Urinary Diagnosis. By J. BERGEN OGDEN, M. D., Boston. (*Philadelphia: W. B. Saunders & Co., 1900.*)

There are so many good works on this subject that the need of another one does not seem very evident, and an author, in presenting a new book, requires to make good his right for recognition. While Dr. Ogden has produced a good book, we doubt if he has furnished a more complete guide to urinary analysis than any single volume yet published, which he states was his aim. The work is divided into two parts, the first dealing with the chemical and microscopical methods of examination, and the second part dealing with urinary diagnosis. The first is much the more satisfactory part of the volume. The tests and methods are clearly described. The first place in the detection of albumin is given to the cold nitric acid test. In the second part of the book the author appears to have gone to very great lengths in making numerous more or less artificial classifications. Thus, under the heading of hyperemia, there are five different conditions described. These complicated divisions are not likely to help the study of kidney disease and urinary diagnosis. In the section on the urine of typhoid fever more than a brief mention might have been given to the question of the occurrence of the bacilli in the urine. The statement that the sediment of typhoid urine "is almost certain to contain . . . a variable quantity of blood, usually a small amount," seems rather a startling one, and it would have been of interest to have had definite statistics given. The majority of writers, in discussing the urine of typhoid fever, fail to note that if large amounts of water be given, as ought to be the case, the classical description of the urine does not hold true. The urine will be abundant and of low specific gravity even early in the disease.

Lectures on Clinical Medicine. By JOHN LINDSAY STEVEN, M. D., Physician to the Glasgow Royal Infirmary. (*Glasgow: Alex. Macdougall, 1900.*)

This volume contains a number of lectures delivered by Dr. Steven in the Glasgow Royal Infirmary. They have previously been published in various periodicals. There are fifteen lectures in the book on various subjects, of which those on Landry's Paralysis, Osteo-arthritis and Scleroderma are perhaps the most interesting. Some more common clinical problems are also discussed, one lecture being devoted to paracutaneous thoracis. The book is interesting, and additional value is given to it by the excellent illustrations.

Atlas and Epitome of Gynecology. By DR. OSKAR SCHAEFFER, Privat-Dozent of Obstetrics and Gynecology in the University of Heidelberg. Authorized Translation from the Second Revised and Enlarged German Edition. Edited by Richard C. Norris, A. M., M. D., Surgeon-in-Charge, Preston Retreat, Philadelphia, Pa. (*Philadelphia: W. B. Saunders & Company, 1900.*)

As mentioned by the author in his preface, the book "occupies a position midway between the quiz compend and the more pretentious works on gynecology." The arrangement adopted is different from that usually seen in gynecological works, the

contents being considered in the five following groups: I. Anomalies of Formation and Arrested Development. II. Changes of Shape and Position. III. Inflammatory and Nutritional Disturbances. IV. Injuries and their Consequences. V. New Growths.

Group I is short and to the point, and from it the student will gain much information. On page 36 the writer says that passive hyperemia of the endometrium is essential as a cause of "congestive endometritis." Congestion naturally produces a thickening of the endometrium, but in no way institutes an inflammatory process. The causes of sterility as set forth on pages 46 and 47 will be of practical interest not only to the student, but also to the practitioner.

On page 73 the reader is informed that the most frequent causes of uterine displacement are perimetritic and parametritic exudates. Misplacements do certainly occur as a result of inflammatory exudates in the tubes or broad ligaments, but in the great majority of cases the altered position is due to a loss of tone in the uterine supports or to rupture of the perineal body.

The histological drawings are particularly instructive, especially those relating to the endometrium. Figures 2 and 4 on Plate 30 might, however, be justly described as normal endometrium, as the mucosa in the healthy individual often presents precisely the same pictures. The author follows the orthodox but erroneous plan of considering eversion of the cervical mucosa (or an occasional extension downward of the mucosa, lining the cervical canal) as erosion, although he admits that the supposed ulcerative area is covered by "pathologic cylindric epithelium."

Numerous authors speak of a dozen or more varieties of endometritis. In this book the number is reduced to eight. In subsequent volumes the classification will probably become still simpler until all cases can be brought under acute, chronic, and, possibly, polypoid forms.

On page 122 we note with satisfaction the statement that in bimanual examinations of patients suffering from acute salpingitis "the greatest gentleness must be exercised in order to avoid the rupture of an abscess or the destruction of an existing encapsulation." The treatment of acute peritonitis accompanying salpingitis is rather antiquated, but Norris here comes to the rescue with editorial notes, giving recent American treatment.

The author is most patient in his treatment of inflammatory cases, and counsels against the removal of the ovaries except "when persistent treatment for years has failed." It is certainly refreshing to find such a conservative man. This conservatism, however, may be carried too far, as on page 201, where he advocates tapping parovarian cysts. Norris here again gives the appropriate advice—"celiotomy and complete removal should take the place of tapping."

The author says (page 137) that the histological differential diagnosis between tuberculosis of the endometrium and carcinoma of the body "is by no means easy." This is erroneous, as the two processes hardly resemble one another in any particular.

Repair of the peritoneum is considered at some length, and here also we are indebted to Norris for the main features of treatment. In the consideration of complete tears we are told that "the edges of the rectal tear must also be freshened and must be united by suture," but little stress is laid on the essential feature—the careful dissection and suture of the two ends of the muscle.

The diagrammatic drawings (pages 166 and 167) illustrating the various urinary fistulae are most instructive. The essential features of tubal pregnancy are also carefully dealt with, but we cannot agree with the author when he relies "on absorption" instead of operative means. The best results are to be

obtained where the pregnancy is diagnosed and the tube removed before rupture.

Under new growths (page 185) most polypi springing from the mucosa are said to be due to "circumscribed inflammatory proliferation," when, as a matter of fact, few polypi show any evidence of inflammation except when exposed to outside influences. Under ordinary circumstances they should be considered as partial extrusions from the normal mucosa. Primary carcinoma of a myoma is said to occur (page 204). Such a change in a pure myoma is impossible, as no epithelial elements are present.

The chapter on "Cancer of the Uterus" contains much valuable information and the symptoms are carefully given. Here again the treatment advocated falls far short of the lines indicated by microscopical examination. "If an epitheliomatous papilloma is certainly limited to the cervix, one or both lips of the os and the affected portion of the vaginal vault may be removed." In every case where carcinoma is present the uterus must be removed, as we can never be sure how far the malignant growth has progressed.

The book contains much valuable material, but the new arrangement adopted makes its reading very fragmentary. The labor expended in the preparation of the drawings must have been very great, and rarely have we seen such a valuable collection of gynecological plates. With a more consecutive and somewhat fuller text, which we hope will accompany the next edition, this will be a useful book for both student and practitioner. In the present edition, indeed, the illustrations alone are more than worth the price of the book.

A Text-Book of Diseases of Women. By CHARLES B. PENROSE, M.D., Ph.D. Third Edition, Revised. (Philadelphia: W. B. Saunders & Co., 1900.)

A review of this work is to be found in the Johns Hopkins Hospital Bulletin, Vol. IX, p. 21, where its merits are discussed. That it has been well received is evidenced by a third edition in so short a period. In the present volume a short account of kraurosis vulvæ has been added on page 46, and on page 500 a note wisely advocating saving the tube and ovary when a parovarian cyst is being removed. Apart from these slight additions the book is practically the same.

Cancer of the Uterus. By THOMAS STEPHEN CULLEN, M.B. (Toronto), Associate Professor of Gynecology in the Johns Hopkins University. With Eleven Lithographic Plates and over Three Hundred Colored and Black Illustrations in the Text by MAX BRÖDEL and HERMAN BECKER. (New York: D. Appleton & Company, 1900.)

Whenever carcinoma of the uterus has passed from its point of origin, so that the surrounding tissues have become involved, or the adjacent glands are already the seat of metastases, the skill of the most experienced operator can avail nothing as regards a radical cure. Palliative measures alone can be resorted to, the patient, despite all our efforts, finally succumbing to a septicæmia from a terminal infection, a toxæmia from the absorption of poisonous necrotic material or to a uræmia following the blocking of one or both ureters. In view, then, of these constant reminders of our helplessness in dealing with the majority of malignant processes of the uterus, the present work must be regarded as a most welcome addition to medical literature, inasmuch as it not only clearly defines our present position, but also contains a wealth of personal, practical observations, clinical and pathological, as well as a judicious review of the best recent literature dealing with the subject. Briefly, Cullen's book, although not supplying us with a cure for cancer of the uterus, nevertheless, by enlightening us with regard to the most recent progress in the study of the pathology, etiology,

treatment and prognosis of such conditions, renders us familiar with the most advanced methods along lines which, in the future, may give a still larger measure of operative success.

As to permanent cure, it suffices to say that at the present time the successful cases are infinitesimally few in number as compared with the overwhelming majority of failures. In view of this fact, we are glad that the author from the very first page has emphasized the necessity of an early diagnosis, pointing out, as is too well known, that the symptoms and signs in these insidious processes are usually meagre. Thus he strenuously advises that in all cases in which the slightest hemorrhage occurs that cannot be satisfactorily explained, an immediate resort to vaginal examination and, as a rule, to a diagnostic curettage, is absolutely necessary. Furthermore, he goes on to say: "It is upon the family physician that we must rely to recognize the early symptoms and to indicate to the patient the appropriate treatment." This necessity for employing every possible means for detecting a malignant growth in its incipency—at the one stage at which cancer is curable—is enforced again and again by precept and by the records of actual cases.

Following this introduction, which supplies the author with a text, with which all his colleagues must be in complete sympathy, are twenty-six chapters, making in all about 700 pages, dealing with every phase of carcinomatous processes of the uterus, fully illustrated by appropriate cases, which have been followed from the operating-room, through the laboratory to their ultimate termination, so far as could be discovered up to the time at which the book was published.

In Chapter II is found a new and instructive drawing which shows very prettily the anatomical subdivisions of the uterus. It is to be regretted that Peiser's recent research had not met the author's eye before the book went to press. Peiser has called especial attention to a set of lymphatic vessels which curve backwards from the base of the broad ligaments and, after coursing through the uterosacral ligaments, empty their contents into bead-like glands along the sacrum. It seems certain that these lymphatic tracts must play a larger part in the development of pelvic metastases than has hitherto been attributed to them.

Accompanying his description of the normal uterine mucosa, Cullen gives several excellent illustrations of the variations incident to increasing age in women. There is no doubt that ignorance of the normal changes in the endometrium is responsible for many mistakes in diagnosis from curettings, mistakes which have not infrequently brought the pathological method of diagnosis into disrepute in the eyes of the somewhat skeptical clinician. Thus, only recently the reviewer came across a specimen almost identical with that shown in Fig. 13, representing a normal cervical mucosa, which had been diagnosed as an adenocarcinoma. To any student who would avoid such mistakes this chapter is particularly instructive, since Cullen shows us the bizarre appearances of the uterine glands when cut at varying angles to the peculiar invaginations seen in normal glands, which might sometimes prove puzzling at first even to a trained microscopist.

With reference to the acute shedding of the superficial portion of the endometrium at the time of the catamenia, which has hitherto been generally taught, Cullen says: "For six years we have paid especial attention to this point and thus far have always found the mucosa intact throughout the monthly period, there being no loss of substance whatever."

Pursuing the subject in regular sequence, in Chapter III, which deals with the removal and examination of uterine tissue for diagnostic purposes, Cullen gives explicit directions for dilatation and curettage, together with the various methods for preserving tissues so that the best possible specimens for microscopic examination can be obtained. The general practitioner is not expected to have the time, even if he has the training,

for an elaborate study of microscopical specimens, but just as an amateur photographer may take a picture and then leave the development of it to the skilled professional, so the practising physician may curette properly, and later send to a competent pathologist specimens preserved in such a way that they are suitable for study. If Cullen's directions were always carefully followed, there would be fewer reports that the scrapings are insufficient or too unsatisfactory for diagnosis.

In Chapter IV, which deals with squamous-cell carcinoma of the cervix, a classification essentially the same, but differing verbally from that of Winter and Ruge is adopted. On the whole, however, for the sake of avoiding confusion, we think it would have been better if the older classification had been maintained.

The transition of the normal into seriously involved tissue is described in detail and well illustrated by appropriate pictures.

Chapter V gives the various routes of extension. The author's statement, that "if the broad ligament is involved to the extent of being palpable, the patient is doomed," is in accord with the view of Freund and other prominent gynecologists. The fact that the liver is so rarely involved in metastatic processes shows that cancer of the uterus differs from cancer of the breast, inasmuch as, in the latter, an early occurrence of widespread lymphatic metastases is the rule. Hence it is to be hoped that, when an early diagnosis is made, cancer of the uterus may still be strictly localized and readily amenable to treatment.

Chapter VII, in which the various pathological processes which might possibly be compared with carcinoma are dealt with, affords very instructive reading.

In his review of the treatment (Chapter VIII) Cullen mentions, as one of the most important advances in operative procedure, the placing of catheters in the ureters. Werder's operation also is fully detailed and highly commended. The accidents which may occur during operation, especially those performed through the vagina, are discussed. Cullen on the whole inclines to the abdominal, and in this view is in accord with the majority of American operators.

It is to be regretted that the author does not refer to the excision of cancerous tissue by means of the thermocautery, a procedure which has proved very successful in the hands of Dr. T. Byrne of Brooklyn.

Chapters IX to XIII and Chapter XVII deal with adenocarcinoma. Chapter XV is especially valuable as showing that a clinically benign growth may sometimes be associated with malignant disease. Other conditions and deciduoma malignum are discussed at length.

The tabulation of cases studied by Cullen affords much interesting information. It is refreshing to note that while the results, as shown in the table, are most depressing, Cullen hopes for much better results in the near future, since he believes early diagnoses will become much more common. We should be inclined to share in this optimistic view were it not for the fact that in the last week we have encountered three inoperable cases in which the disease had been so insidious that the patients had first complained to their family physician only a few days previous to admission to the hospital.

The various theories dealing with the cause of carcinoma are discussed, but the conclusion is reached that "the etiology is still an unsettled question." Reference is made to inoculation experiments pointing to the possibility of the implantation of carcinomatous tissue on a healthy surface, and the operator is warned to guard against this danger.

The book concludes with an extensive quotation from a paper by G. T. Knowsley Thornton, entitled "A Plea for the Early Diagnosis of Malignant Disease of the Uterus."

While feeling that unstinted praise is due to this magnificent monograph, the reviewer regrets that, as the book is intended

for all classes of physicians, the matter has not been arranged somewhat differently. The first half of the book might well have been devoted to an unbroken, epitomized narrative of the author's own work and his conclusions, which might have been followed by his splendid array of illustrative cases. With the present arrangement it is to be feared that not a few readers will fail to extract all the rich meat which the book contains. At the same time it must be said that this defect is one of very few among the many excellences, which have evidently resulted from indefatigable personal research and a thorough understanding of the subject.

The value of the subject-matter has been materially advanced throughout by the excellent original drawings of Messrs. Brödel and Becker, and the author has every reason to be satisfied with the way in which the publishers have presented his work to the public.

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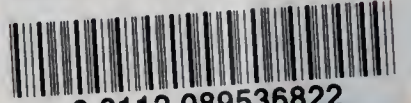
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